Instruments

IE MAGAZINE of MEASUREMENT and CONTROL

Vol. 21 | OCTOBER 1948 | No. 10

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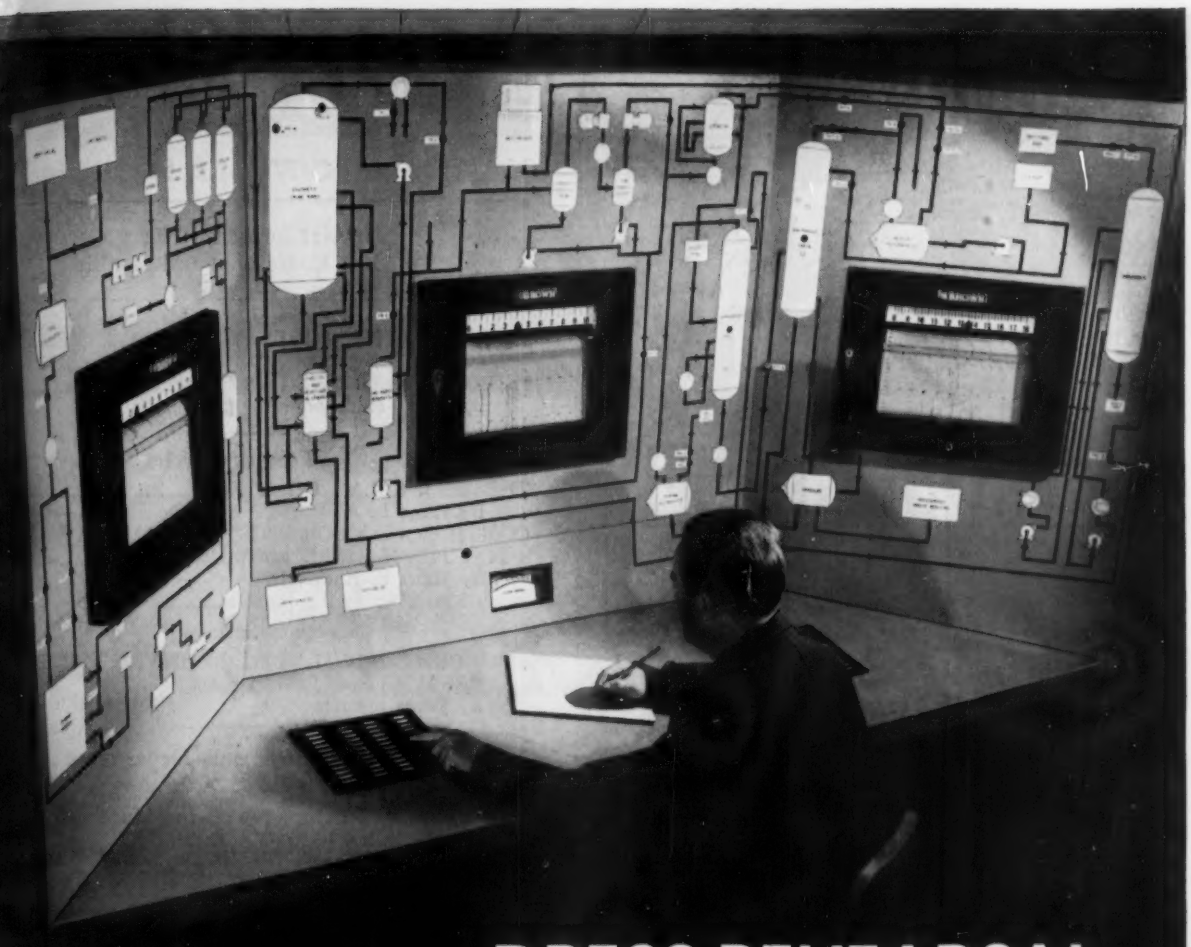

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Brown engineers have rehearsed at this console for many hours—determining the ease of analyzing and supervising complete operations. They have set up all foreseeable difficulties of future plants. They are exploring tomorrow's instrumentation job—today.

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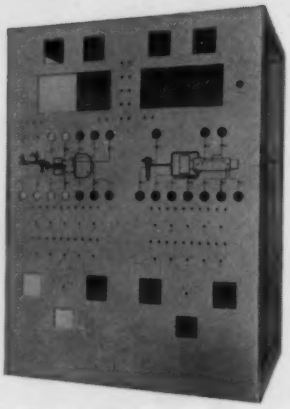
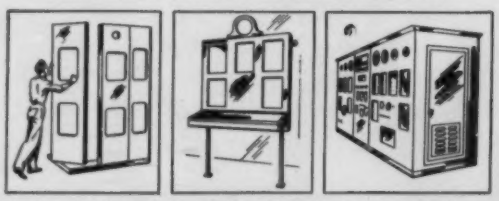
FINE MACHINE TOOL
. . . in a
FALSTROM PANEL



Falstrom refinery cubicle with mimic flow diagram in five colors.

TO the casual observer, this panel would merely be an example of particularly good metal workmanship. The engineer or technician, however, would see an additional asset. He would see at a glance that this cubicle had been properly designed, constructed and finished for high grade refinery service where nothing but the finest in materials or workmanship was tolerated. He would know this by the smooth cutout edges, non-glare surface coating, careful, professional multi-color diagramming and general overall top notch construction. Falstrom wants to build cubicles of this type for you; may we quote on your requirements. Write for Bulletin 119S.

STRUCTURES FOR EVERY CONTROL REQUIREMENT



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Instruments

Vol. 21 **OCTOBER 1948** No. 10

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Gas cycling and maintenance operations at the Hastings Plant call for pressures varying from slight vacuum for rich or wet gas to 3,500 P.S.I. when dry gas is pumped into the wells for gas lift and conservation purposes.

Efficient operation of this plant with a daily throughput of 35,000,000 cu. ft. calls for measuring instruments of highest accuracy and dependability.

Metric Orifice Meters are effectively serving the exacting requirements of this plant at Hastings. The California Company's Lake St. John and Cranfield Plants; Shell's Sheridan Plant; Humble's Katy, Tom O'Connor, Anahauc, Clear Lake Plants, and others are demonstrating the suitability of Metric Orifice Meters for high pressure applications up to 5,000 P.S.I.

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Metric Meter High Pressure type, test 8,000 pounds, measures and records operation of gas return. Around 20,000,000 cu. ft. of dry residue are forced into sand daily at 3,500 P. S. I.

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INSTRUMENTS ON THE MARCH

Navy Demonstrates World's Largest Universal Testing Machine

SEE FRONT-COVER PHOTOGRAPH

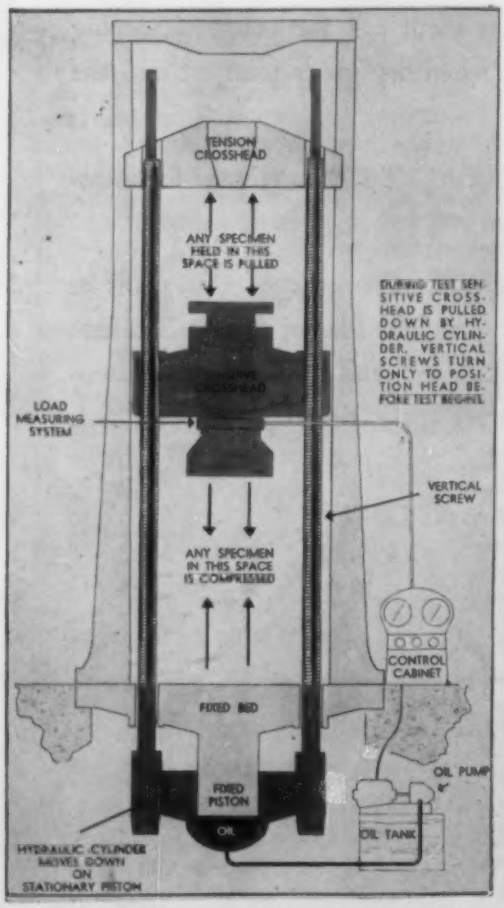
PHILADELPHIA, Sept. 23.—Today at the U. S. Naval Air Experimental Station, a subordinate unit of the Naval Air Material Center, the largest universal testing machine in the world was demonstrated the first time officially in the Aeronautical Structures Laboratory at the Philadelphia Naval Base. It is a 5,000,000-pound capacity machine built to Navy specifications by The Baldwin Locomotive Works. Paradoxically this 5,000,000-lb. capacity machine will be used for testing the lightest-weight aluminum and magnesium structures that aeronautical engineers can design to meet the severe requirements of modern flight.

There has been a growing realization that the behavior of structures often cannot be adequately predicted from tests of the specimens of materials used in the structure and by theoretical analysis of stresses. This has been especially true in aircraft design where weight must be minimized. As the size of the aircraft structures has grown larger, larger testing machines were required to apply loads equal to or greater than those encountered in flight.

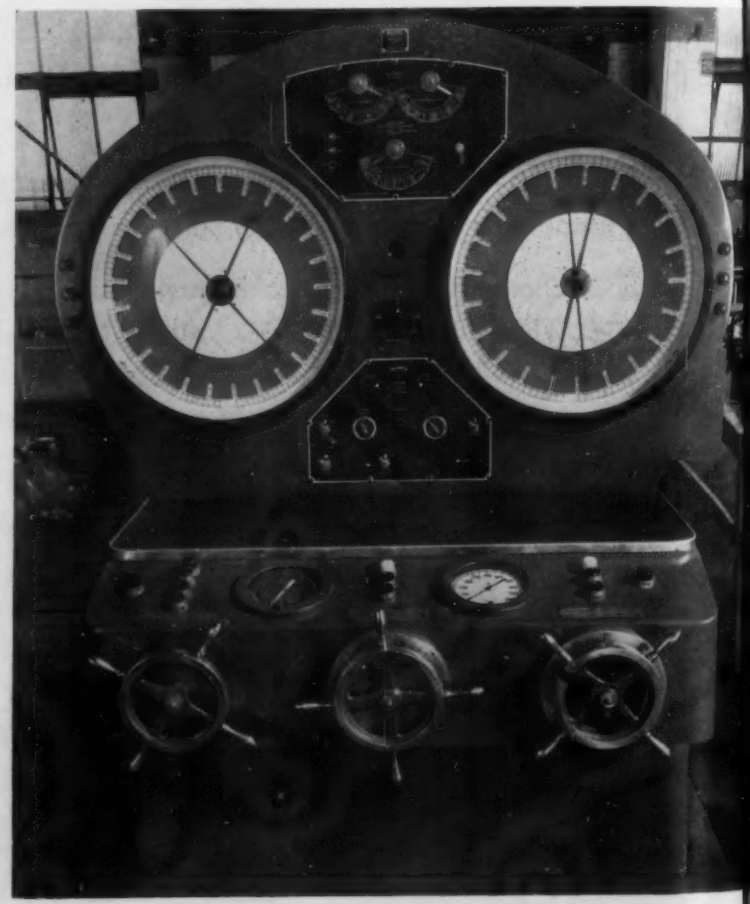
In present-day tests, stresses may be determined at one hundred or more points while the test structure is being subjected to increasing, measured loads. This testing machine makes it possible (1) to measure the loads that the largest and strongest airplane structural elements will withstand, (2) to modify their design and minimize weight with assurance that any unforeseen and u predictable concentrations of stress w be detected and eliminated, and (3) solve the principal problems of desig ing full-scale aircraft on the basis small-scale model design and tests.

Tests of structures today yield f more than a stress-strain curve endi at a break of a test specimen. By mea of SR-4 bonded resistance wire stra gages on aircraft structures, pane beams, etc., in testing machines, t Navy's Aeronautical Structure Labor tory will determine stresses at as ma points as may be required to sho where added strength may be requir or where material may be removed reduce weight. These measuremen will be made at many measured loa below and approaching the breaki point of the test specimens. Such stre measurements will be made rapid with the aid of automatic equipme that will record 48 gage readings in seconds. [An article on this autograph equipment is being prepared for *Instr ments.*]

The load-measuring system of t new machine consists of an Emery ce carried by the sensitive crosshead, a a Tate-Emery indicator with two ind cating dials and accessory equipme in a cabinet beside the machine. Th cabinet also contains operating co trols. Emery cell and indicator are co


TENSION CROSSHEAD
ANY SPECIMEN HELD IN THIS SPACE IS PULLED
DURING TEST SENSITIVE CROSSHEAD IS PULLED DOWN BY HYDRAULIC CYLINDER. VERTICAL SCREWS TURN ONLY TO POSITION HEAD BEFORE TEST BEGINS
LOAD MEASURING SYSTEM
VERTICAL SCREW
ANY SPECIMEN IN THIS SPACE IS COMPRESSED
CONTROL CABINET
FIXED BED
OIL PUMP
FIXED PISTON
OIL
OIL TANK
HYDRAULIC CYLINDER MOVES DOWN ON STATIONARY PISTON

Machine consists essentially of (1) loading system, (2) weighing system and (3) control system.



All controls are contained in this cabinet. The three large handwheels control load application speed, instant release, and fast-motion.

NEW 1/8" Type 316 STAINLESS STEEL CAPILLARY

that Needs No Protective Tubing

ANOTHER FOXBORO FIRST

The bulb and capillary tubing shown above are one continuous welded assembly of Type 316 Stainless Steel. It is flexible, yet so strong that it is practically damage-proof. Superior for *any* application using a vapor pressure thermal system.

This "Foxboro First" offers far greater resistance *throughout* to corrosive atmospheres and vapors than ever achieved before . . . and *it costs no more.*

When you specify this new development for applications where corrosive atmosphere is a problem, you can count on extended service life and sustained accuracy. For complete details write to **The Foxboro Company, 46 Neponset Ave., Foxboro, Mass., U. S. A.**

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RECORDING · CONTROLLING · INDICATING
INSTRUMENTS

nected only by a flexible tubing for transmission of hydraulic pressure.

The Emery cell is essentially a shallow cylinder having a loose-fitting piston and a metal diaphragm so arranged that the load on the specimen produces a pressure change on a thin film of liquid trapped between the piston (and diaphragm) and the bottom of the cylinder. Relative movement of piston and cylinder is practically negligible.

The flexible tubing from the Emery cell ends in a Bourdon tube in the indicator. The Bourdon tube does not directly actuate the indicator pointer on the dial, but effortlessly commands a pneumatic servo system. Opposing force is applied through highly accurate load-measuring springs, the extension of which is magnified by an indicator pointer on a 66″ scale on the dial. Six ranges are provided by six Bourdon tubes and airjet baffles, and two bellows servo motors and dials.

One of the largest accessories is an elevator consisting of a platform surrounding the machine [see cover photo]. A 15-hp. motor raises and lowers the elevator at 12 ft. per minute.

For the safety of the operator the control and indicator cabinet is located at one side where tests can be watched and controlled most conveniently. The machine has also been equipped with a safety screen to prevent heavy parts of breaking specimens from being thrown away from the machine.

In some tests it is desired to maintain a constant rate of increasing load. For this purpose the machine is equipped with a load rate pacing disk and associated automatic controls. In other tests it is desirable to maintain a constant rate of straining the test specimen. A similar strain rate pacing disk and associated automatic controls will hold the strain rate constant. A motion indicator is also supplied for the sensitive crosshead. In addition, the machine is equipped with a self-contained autographic apparatus for making load-elongation records on charts.

BY J. M. DAILEY, LAKE CHARLES, LA.

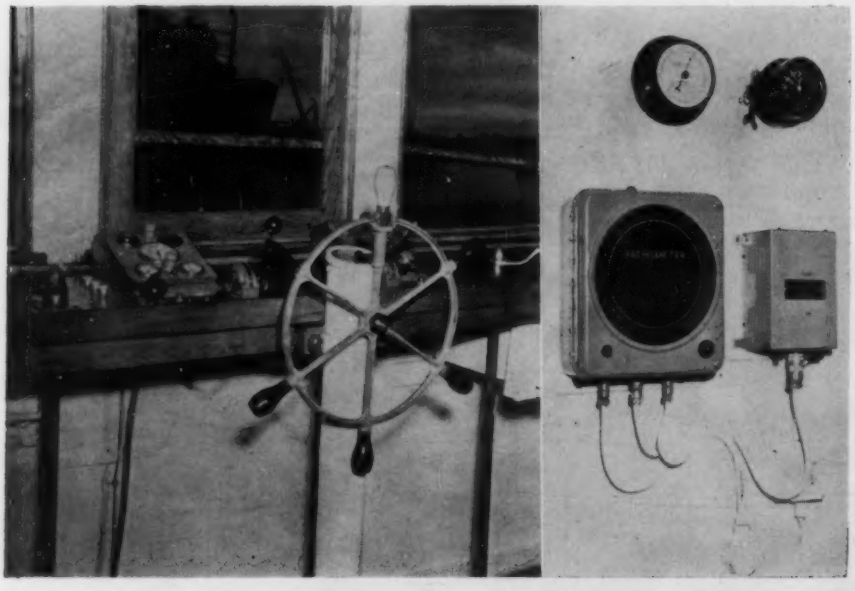
Navy's Fire-control Schools

With the control of guns becoming an increasingly important feature of naval gunnery, in 1924 the name and curriculum of the old Seaman Gunnery School at the Naval Gun Factory, Washington, D. C., was changed to the Advanced Fire Control School.

The school grew by leaps and bounds. For many years both officers and enlisted personnel attended it, but the number of students grew so large that in 1944 a separate school was established for officers. In 1946 a second split took place, and the Fire Control Technician School was established. The latter school was set up with an intense one-year course, designed to produce fire control maintenance men. Graduates of the Advanced Fire Control School retain or strike for the rating of fire controlman under the new rating structure while graduates of the Fire Control Technician School become fire control technicians (FT).

Currently the course at the Advanced Fire Control School is of 33 weeks' duration. Students range from CPOs to seamen fire controlmen strikers. All take the same course. Some civilian navy yard ordnance workers also are given the course along with the sailors. At present the school is turning out about 26 graduates per month and is staffed with 28 instructors (21 FCCs, four ICCs, two EMCs and one ET1).

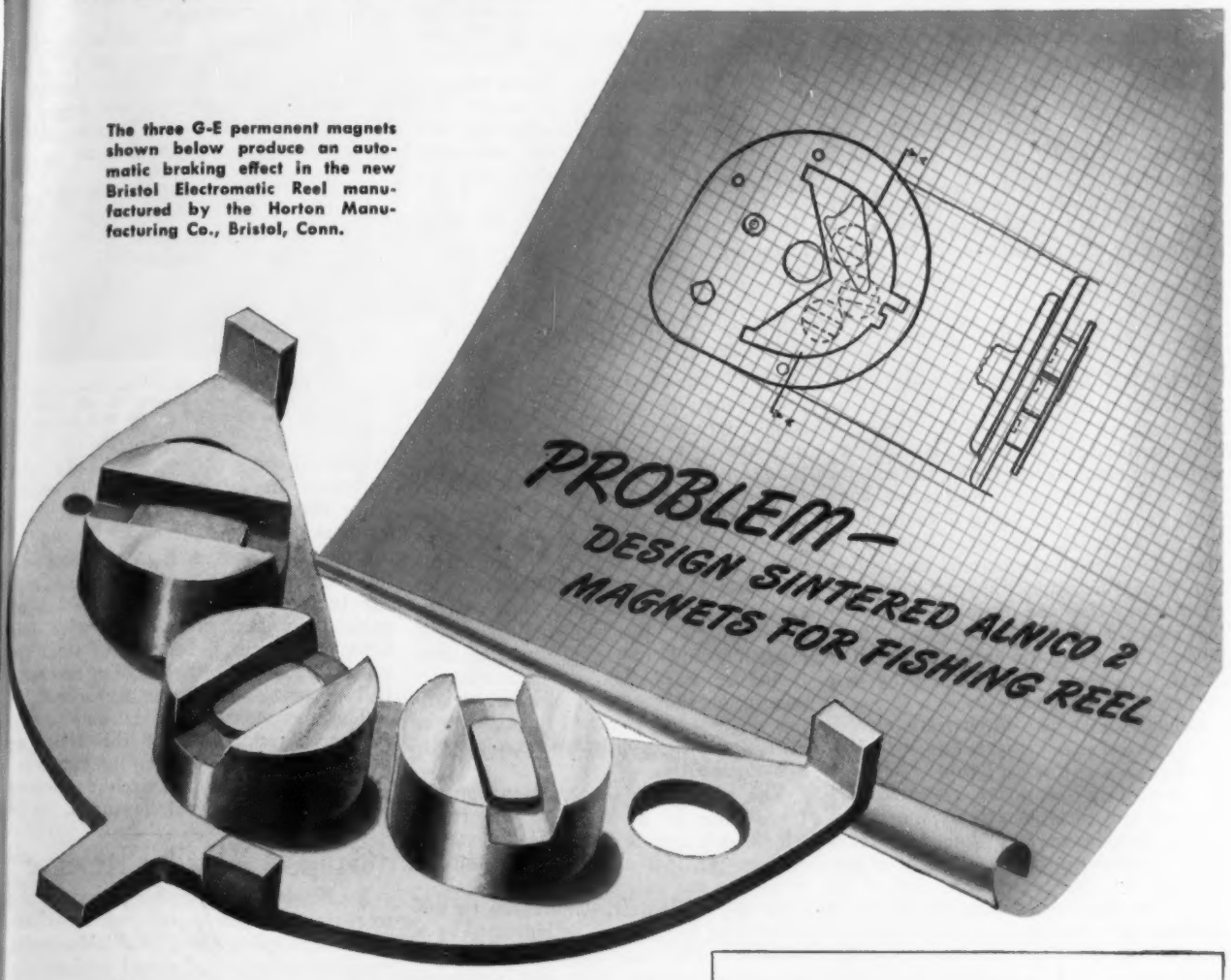
Covering 1,386 hours of instruction, the current curriculum at the school is divided into 12 basic subjects. Students study basic mathematics for 42 hours, basic electronics and electricity for 294 hours, basic fire control for 187 hours and the fuse setting indicator regulator



POSTWAR CIVILIAN FLEETS ALSO WELL INSTRUMENTIZED.—Down the ways of Mill Basin Ship Repair (Brooklyn, N. Y.) recently went the 50-foot twin-diesel tug *Mooremack T-3* destined for service in the Amazon river. This small craft carries many instruments unknown even to luxury-liner skippers of a generation ago. *(Left)* Wheelhouse of tug looking towards the bow. View shows both engine control panels, starting buttons, hydraulic throttle controls, wheel, and forward and reverse controls. *(Right)* Fathometer, Jr. installation. Unit acts as depth indicator and protects vessel when navigating shallow water areas. Also shown, ship's clock and barometer.

YOU GET QUALITY PLUS ENGINEERING SERVICE WITH G-E PERMANENT MAGNETS

The three G-E permanent magnets shown below produce an automatic braking effect in the new Bristol Electromatic Reel manufactured by the Horton Manufacturing Co., Bristol, Conn.

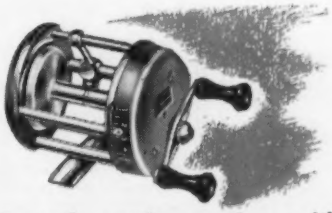


The magnets that brake your reel

Now it's G-E permanent magnets for greater accuracy in casting. The permanent magnets shown above develop a non-friction braking action directly in proportion to the speed of the plug. Maximum braking is applied at the start of the cast and, as the spool is slowing down, the braking effect decreases automatically.

G-E permanent magnets are continually finding wide application in many fields. The magnetic reel is but one example of the adaptation of an industrial magnet engineering principle to an entirely different field.

Perhaps there's a use for G-E permanent magnets in your product. Or, you may wish to improve your present magnet design for greater efficiency. Our engineers will be glad to work with you to improve your product. For details and your free copy of CDM-1, G-E PERMANENT MAGNETS, *write Metallurgy Division, Section CS-10, Chemical Department, General Electric Company, Pittsfield, Mass.*



Smooth casting action with the Bristol Electromatic Reel

Three G-E Sintered Alnico magnets are mounted on a non-magnetic plate having adjustable air gap. A bi-metallic disc of copper and steel mounted on the end of the spool cuts the lines of force of the permanent magnets. The eddy currents induced set up electromagnetic poles which repel the permanent magnet poles producing a drag on the speed of the spool. Since the strength of the electromagnetic poles depends on the speed of rotation of the spool, this braking effect is automatically applied at all times in just the right amount. Outstanding advantages of this new reel are smooth casting action, greater accuracy, and freedom from backlash.

PERMANENT MAGNETS

GENERAL ELECTRIC

CDM8-V4

for 23 hours. 210 hours are spent learning the power drives, 84 hours on gun directors, 84 hours on the stable element and 168 hours on computors and rangekeepers. Men receive 168 hours of instruction on the gun fire control system, 42 hours on radar familiarization, 15 hours on parallax correctors and relay transmitters and 69 hours on battery alignment.

The future of fire control, with its wide field of possible application, is fascinating. For instance, if at some future date an enemy launched an atomic rocket at the U. S., it is possible that fire control equipment, on board a ship patrolling miles offshore, will have been perfected to the point where it will automatically detect the rocket while it is still thousands of miles away, fire a counter-rocket from the ship that will unerringly "seek out" the oncoming missile and detonate it while still far from the shore.—EARL SMITH, PNC, USN, in *ALL HANDS* (U. S. Navy magazine).

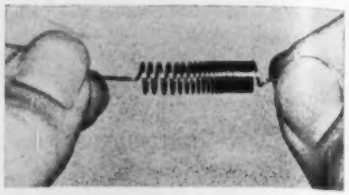
Variable-resistance Spring Transducer

WASHINGTON, D. C.—According to Technical Report 1286 of the National Bureau of Standards, a highly-sensitive mechano-electrical transducer, which transforms slight displacements into large changes of resistance, current, or voltage, is being developed by W. A. Wildhack and his NBS associates. The active element of the device is a helical or conical spring wound in such a way that the initial tension varies slightly along its length. Thus, when the ends of the spring are pulled apart, the turns separate one by one rather than simultaneously.

When the spring is entirely closed, its electrical resistance is approximately that of a cylindrical tube. When it is completely open, its resistance is that of the total length of the coiled wire. Resistance can thus be varied over a wide range by stretching the spring. As the percentage change in resistance may be hundreds of times greater than the percentage change in length, displacements as small as ten microinches can be easily measured without the use of electrical amplifying devices. The spring transducer thus provides a sensitive means for conversion of any mechanical displacement to a change in an electrical magnitude that can be precisely determined. When connected to a primary measuring element which gives a mechanical displacement output (a bimetallic strip responding to temperature changes, for example), the combination gives an easily measurable electrical output. This type of use suggests numerous scientific and industrial applications, including strain gages, pressure elements, accelerometers, electric weighing devices, automatic temperature controllers d-c. a-c. inverters, and voltage regulators.

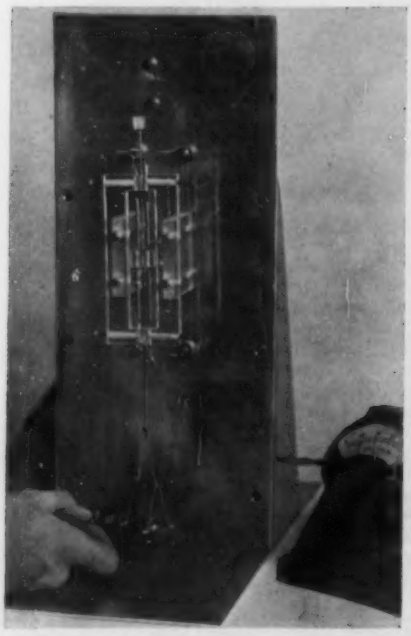
The preferable construction for the transducer is a four-arm bridge of which each arm is a variable-resistance spring. An increase in applied tension elongates one pair of springs and shortens the other pair. The resistive unbalance of the bridge, as indicated by a galvanometer, thus gives a measure of the displacement that has occurred. With this arrangement, since the voltage can be nearly reversed through the bridge, the output can be theoretically twice the input voltage.

The variation of the initial tension of the spring along its length may be accomplished in several ways: by conical winding, by varying the angle of feed of the wire on a uniform mandrel, or by varying its tension as it is wound. For greatest sensitivity the variation in initial tension is made quite small. To decrease contact resistance between successive turns of the closed spring, a high average initial tension is built into the spring, and the turns are coated with 0.0001" of gold. Thus far, nickel-alloy wire has been mainly used, because of its high resistivity and small change of mechanical properties with temperature.

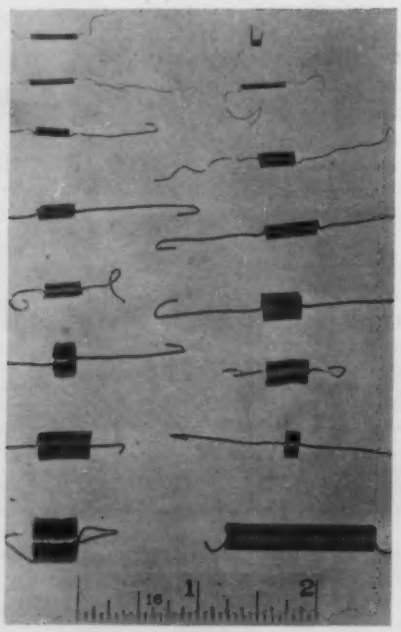


The progressively greater separation of this stretched spring along its length illustrates the basic principle of the new mechano-electrical transducer.

The new transducer is undergoing further development at the NBS as part of a project on basic instrumentation for scientific research supported by the Office of Naval Research.



Experimental model. Longitudinal displacement of the rod which bisects the apparatus is being produced by the addition of small weights below. This elongates one pair of springs and shortens the other pair.



Some types and sizes of variable-tension springs wound at the National Bureau of Standards, in connection with the further development of the variable-resistance spring transducer designed at the Bureau.

Guided Missiles Reserve

In World War II planes and bombs were developed to operate with mechanical brains by means of television, radio, radar, magnetic and sound devices.

A common interest in this comparatively new field, which has important peacetime as well as war uses, has brought together a group of specialists who have formed the Naval Reserve's Pilotless Aircraft Unit W-1, first of its kind in the country.

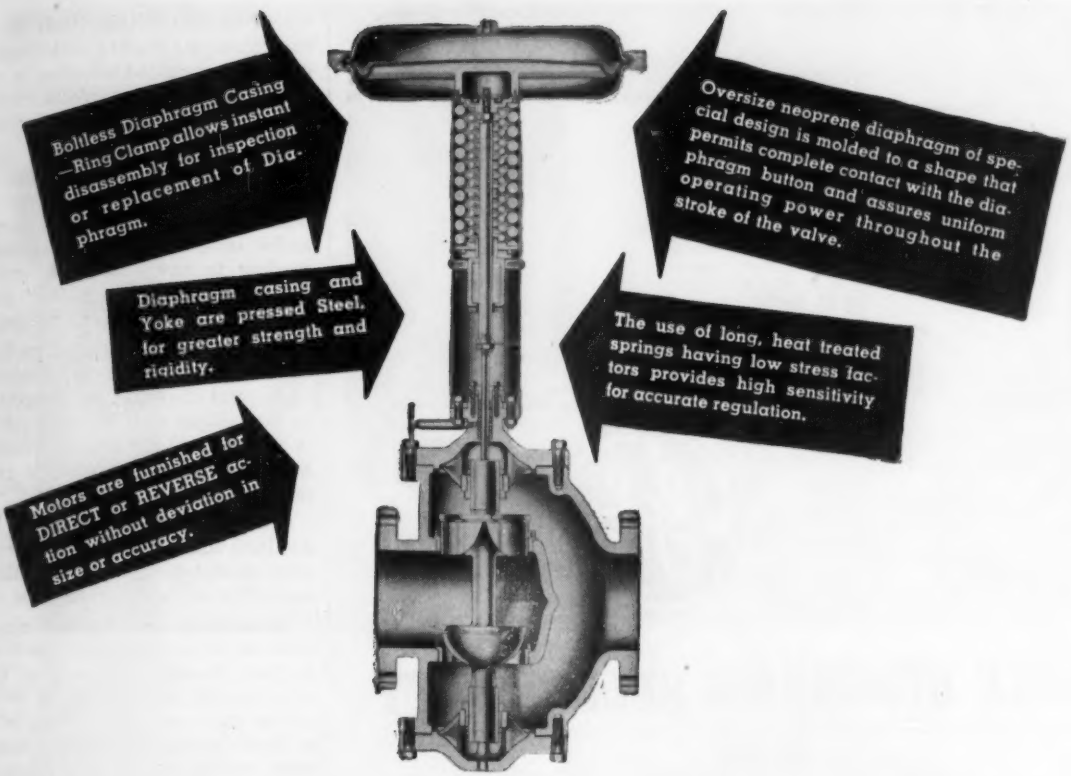
Meeting at the Reserve Training Center in the Naval Gun Factory, Washington, D. C., the 30 officers of this unit are keeping up with the constantly-changing techniques and improvements in the world of the guided missile, preparing themselves for their potential role in the event of mobilization.

The volunteer group is studying a syllabus beginning with the first engineering developments in guided missiles and covering operational procedures, power plants and current use of pilotless aircraft in the Fleet.

Volunteer Pilotless Aircraft Unit W-1 confines its activities to classroom study, lectures and research. Participation in the actual operation of pilotless aircraft is provided during annual training at the Naval Air Missile Test Center, Point Mugu, Calif.

A textbook is being prepared by the office of the Chief of Naval Operations to assist Reservists training in the field of pilotless aircraft and guided missiles.

A guided missile is defined as one


Boltless Diaphragm Casing —Ring Clamp allows instant disassembly for inspection or replacement of Diaphragm.
Oversize neoprene diaphragm of special design is molded to a shape that permits complete contact with the diaphragm button and assures uniform operating power throughout the stroke of the valve.
Diaphragm casing and Yoke are pressed Steel, for greater strength and rigidity.
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Motors are furnished for DIRECT or REVERSE action without deviation in size or accuracy.

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The COMPLETE Kieley & Mueller line contains many design advances for closer regulation, easier maintenance in the Automatic Control of Pressures, Flows, Temperatures and Liquid Level. For specification data, write for Catalog 47.

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Pilot or Direct Operated Liquid Level Controls—Float Valves—Balanced Lever Valves—Ball Float Drainers—30 pages.

Strainers—4 pages.

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with
NO LOSS of AUDIO RESPONSE

WHEN connected to a conventional communications receiver, the General Electric Single Sideband Selector Type YRS-1 permits single sideband reception of modulated, unmodulated (CW) or single sideband transmissions. Although the system provides the effect of extreme selectivity, the audio fidelity of the selected sideband is restricted only by the fidelity characteristics of the receiver itself. Interference on either sideband can thus be minimized without impairing the quality of the signal you are trying to copy.

- Single sideband reception of modulated, unmodulated (CW) or single sideband transmissions.
- Provides the effect of extreme selectivity without restriction of audio fidelity.
- Push-button selection of either sideband—other sideband attenuated.
- Audio distortion associated with selective fading is greatly reduced.
- Intelligibility of fading signals is improved.
- Can be connected to practically any communications receiver having an intermediate frequency of approximately 455 KC.
- Normal operation is in no way disturbed when single sideband selector is not in use.

For complete information on the single sideband selector write: *General Electric Co., Electronics Park, Syracuse, N. Y.*

165-G5

GENERAL ELECTRIC

which carries within itself the "means to control its flight." Pilotless aircraft differ from guided missiles in that they are equipped with airfoils (wing, aileron or rudder surface) for sustained flights.

The program syllabus followed by the Reserve unit during its training sessions covers the various engine principles involved in guided missiles. According to naval experts, two general classes of "reaction motor" propulsion are used in the modern guided missile.

First is the true rocket motor, which carries its own oxygen, enabling it to fly beyond the earth's atmosphere layer. It uses either dry or liquid fuel. Second is the thermal air engine, which utilizes a stream of air to provide the necessary oxygen.

A typical liquid fuel rocket burns an aniline compound and nitro-sulfuric acid mixture, gasoline or alcohol, alternating with liquid oxygen.

Airstream or thermal air engines have an advantage over the true rocket in that the size and weight of the missile can be reduced since it need not carry its own oxygen supply. It is at a disadvantage because it can operate only within the limits of the earth's atmosphere.

The "flying stovepipe," one of the Navy's most recently developed missiles, is a type of thermal air engine called ram jet. The simplest of airstream engines, it consists of a duct open at both ends with no moving parts. Fine jets of fuel are injected under pressure into the tube. The fuel is ignited with air entering the nose and compressed by the shape of the forward part of the duct.

A second type of thermal air engine is represented in the Navy's Skystreak, a piloted aircraft which recently set a world speed record. The turbo-jet, the principle on which its engine operates, may be applied to guided missiles. In the turbo-jet the air needed for combustion is forced into the combustion chamber by a rotary compressor that is driven by a gas turbine. The turbine is mounted on the same shaft as the compressor and is activated by the gases resulting from the explosion, forming a continuous propelling jet.

Mock-ups, models of guided missiles, and various training aids are being provided by the Navy to aid in instruction of members of the Reserve unit. Civilian scientists and research personnel conduct lectures and show special films on experimental work now being done.

The first jet-propelled, radio-controlled, pilotless aircraft to make a successful flight in the United States was the Gorgon. It was one of the trio of guided missiles, now obsolete, which included the Glomb and the Gargoyle, a rocket-powered bomb controlled by radio.

Improving on missiles and pilotless aircraft during the war, the Navy has made public some of its more recent de-

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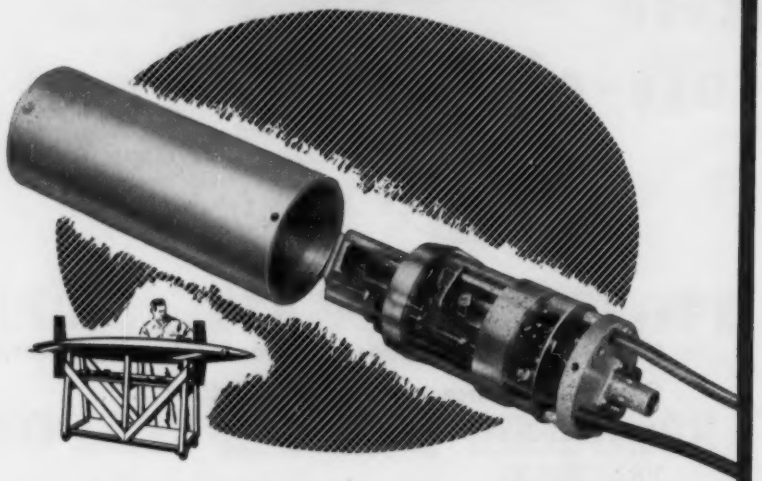
FOR THE NEW TELEMETERING BAND

Bendix Pacific

MODEL TXV-2A

TRANSMITTER

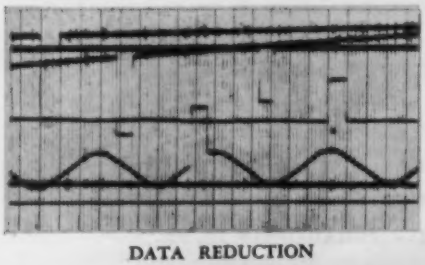


The Bendix Model TXV-2A Transmitter is a VHF direct FM transmitter developed to supplement a complete line of telemetering components designed for use in the FM/FM subminiature telemetering system.

Complete telemetering facilities are available at Bendix Pacific including not only the manufacture and supply of components, but also installation and application engineering, field operations, data reduction and engineering consultation.

SPECIFICATIONS

Frequency range: 209 mc to 227 mc
Modulation: to ± 125 kc
Power required: 135 volts at 40 ma and 6 volts at 0.45 amp.
Nominal output: 0.5 watt into 51.5 ohms
Weight: .875 pounds
Case Dimensions: 2 inches in diameter–5⅛ inches long (excluding connectors)



DATA REDUCTION

Additional information on the TXV-2A Transmitter or other telemetering components or services is available upon request from qualified companies.

PRODUCT OF Bendix AVIATION CORPORATION

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velopments, including the Bumblebee, powered by a ram jet engine; the Loon, a refined German V-1 buzz bomb; and the KDs, pilotless aircraft powered by jet or gasoline engines.

Included in Unit W-1's training syllabus is the study of the target drone, used by the Navy in gunnery practice, and methods of recovering these pilotless aircraft at sea.

Guided missiles may serve a peacetime purpose. Airmail of the future may be carried in long-range missiles. Rockets equipped with scientific apparatus can probe beyond the blanket of the earth's atmosphere to obtain data of cosmic rays and other phenomena.

The members of Pilotless Aircraft Unit W-1, forming the nucleus of a Reserve group which is continuing its specialized training in civilian life, will fit into a hard-to-fill niche in the Navy in the event of mobilization. — *ALL HANDS* (U. S. Navy magazine).

TECHNICAL SOCIETIES

Conference on Electronic Instrumentation in Nucleonics and Medicine

The first comprehensive display of radiation detection instruments will be presented at a conference on electronic instrumentation in nucleonics and medicine in New York, Nov. 29 through Dec. 1, according to an announcement by Adrian Dahl, Chief Radiation Instruments Branch, U. S. Atomic Energy Commission, Oak Ridge, Tenn.

The conference will be sponsored by The Institute of Radio Engineers and the American Institute of Electrical Engineers. In addition to the instrument display, the U. S. AEC is planning exhibits.

The program will include more than a score of parers presented by leading authorities active in development of atomic energy for commercial and scientific application.

[For further information, write to Institute of Radio Engineers, 1 East 79th St., New York 21, N. Y.]

SESA

The Annual Meeting of the Society for Experimental Stress Analysis will be held at Hotel Commodore, New York, N. Y. on December 2, 3, 4, 1948. Inquiries should be addressed to the Society for Experimental Stress Analysis, P. O. Box 168, Cambridge 39, Mass. —W. M. MURRAY, *Sec'y-Treas.*

National Electronics Conference

Final plans have been completed for the 1948 National Electronics Conference which will be held at the Edgewater Beach Hotel, Chicago, on November 4, 5, and 6.

A comprehensive technical program has been arranged, with all major fields of interest being covered.

Further information concerning the Conference may be obtained by addressing Dr. R. R. Buss, Secretary, in care of the Electrical Engineering Department, Northwestern University, Evanston, Illinois.

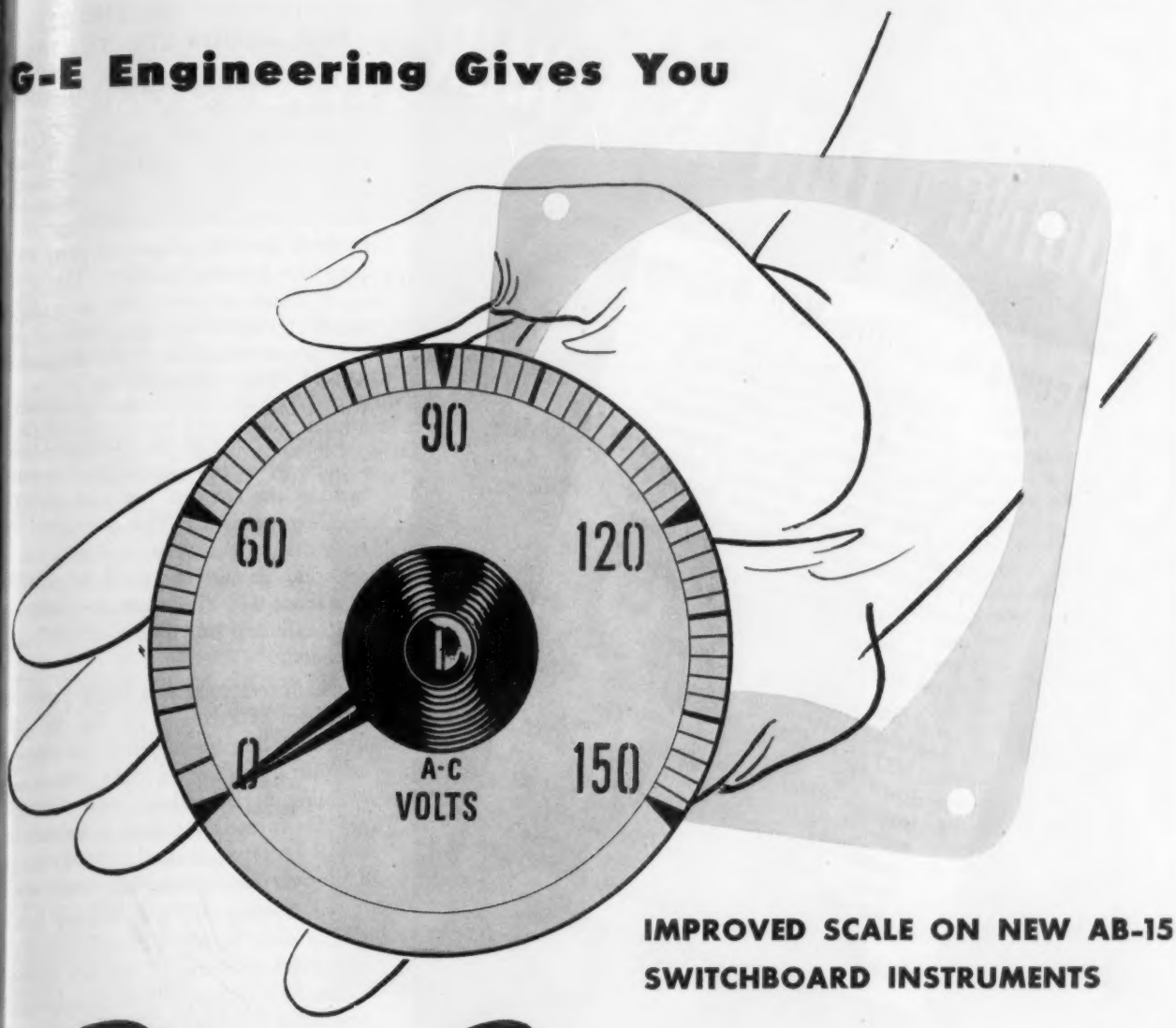
Inspection Group

An "exploratory meeting" of persons interested in inspection, gaging and testing will be held in the Hotel Henry, Pittsburgh, November 18 at 8 p. m.

A Symposium on Dimensional Gaging With Air Gages will be presented, consisting of papers by representatives of Federal Products, Moore, and Sheffield.

Formation of a permanent organization will be discussed.

G-E Engineering Gives You

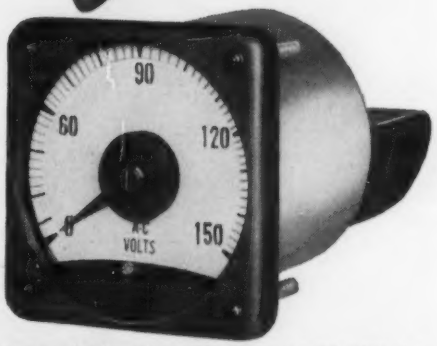


IMPROVED SCALE ON NEW AB-15 SWITCHBOARD INSTRUMENTS

Better Readability

Precise reading with the least effort. That's what you get with the new General Electric switchboard instruments. Here's why: (1) Long scale (7.1 inches) spans 250 degrees with all figures reading laterally instead of on a curve, (2) Circular mask covers mechanism at center of dial emphasizing pointer and figures, (3) Anti-parallax arrangement of pointer assures accurate indications from any reasonable angle, (4) Anti-glare glass minimizes reflections, (5) Accented main scale division lines simplify reading, (6) Over-all scale has been simplified by elimination of extraneous printing.

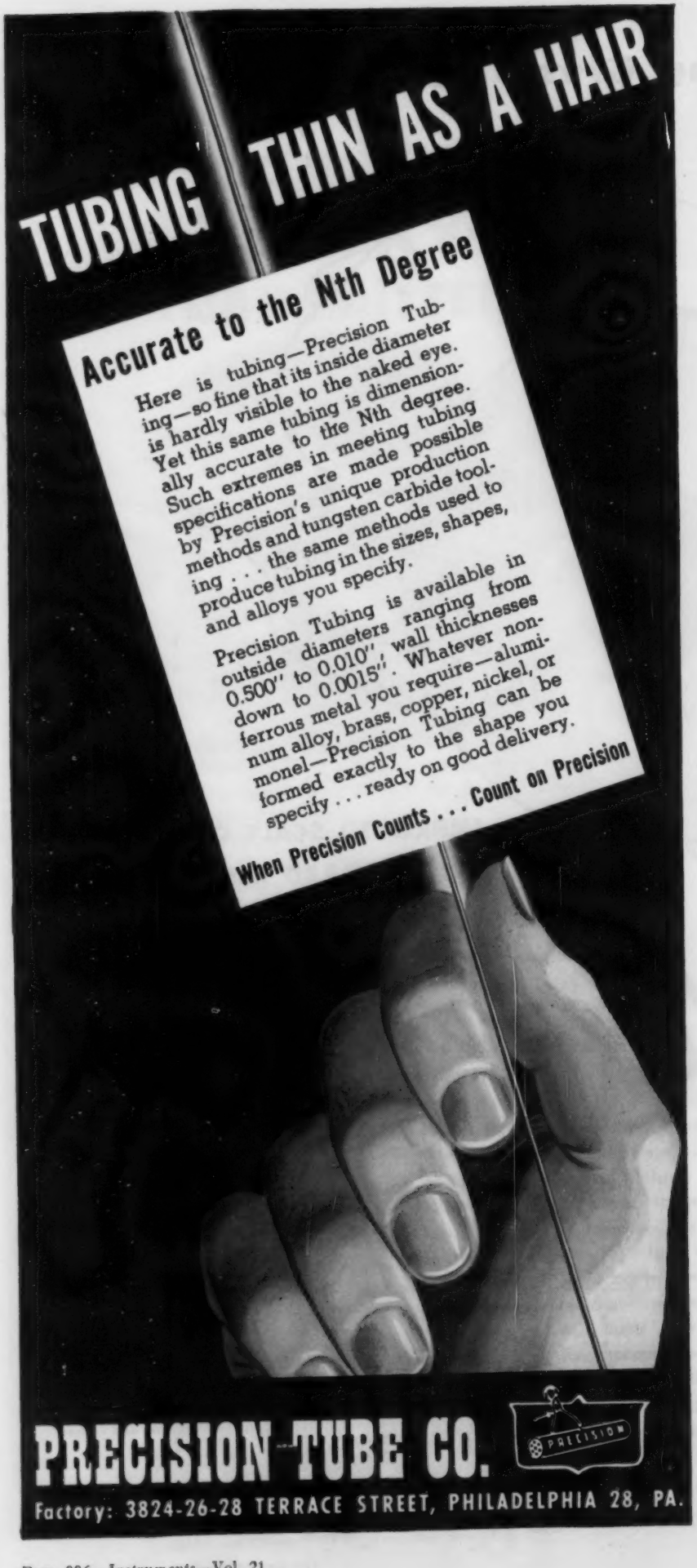
Other features like spring-mounted jewels, small size (only 4½ inches square), and "unit" design assure sturdiness, economy of space, and ease of service. Be sure of the best for your switchboard instruments. Insist on the new G-E long-scale instruments. GEC-218 gives details. Write for your copy today. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



Also available as a-c ammeter, a-c wattmeter, d-c voltmeter, d-c ammeter, temperature indicator, power-factor meter, synchroscope, and frequency meter.

GENERAL ELECTRIC

660-128


TUBING THIN AS A HAIR
Accurate to the Nth Degree
Here is tubing—Precision Tubing—so fine that its inside diameter is hardly visible to the naked eye. Yet this same tubing is dimensionally accurate to the Nth degree. Such extremes in meeting tubing specifications are made possible by Precision's unique production methods and tungsten carbide tooling . . . the same methods used to produce tubing in the sizes, shapes, and alloys you specify.
Precision Tubing is available in outside diameters ranging from 0.500" to 0.010", wall thicknesses down to 0.0015". Whatever nonferrous metal you require—aluminum alloy, brass, copper, nickel, or monel—Precision Tubing can be formed exactly to the shape you specify . . . ready on good delivery.
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TOOLING METHODS FOR ACCURATE TUBING

The days of considering accuracy as an art are definitely over. Accuracy has passed from a fickle result of the artisan's skill, to a predictable controllable result of repetitive production and proper tooling. Modern assembly methods demand component parts with complete interchangeability. The principal advances have been in tooling, annealing, lubrication, gauging, and the use of statistical methods of quality control. This discussion is concerned with tooling.

In operations at the Precision Tube Company, we have found that tungsten carbide dies are best for cold drawing non-ferrous metals. This is true for all sizes except the very smallest, where diamond dies are still used. In general, dies above 0.050" in diameter are tungsten carbide, and below 0.050" are diamond.

Die maintenance is a major problem. We here at Precision do our own die finishing. Suspended boron carbide in a mineral vehicle is used for rough grinding in a machine, and diamond powder is used for final polishing by hand. Dies which need refinishing are made over into substantially larger sizes.

For drawing over a stationary inside tool or plug, tungsten carbide materials are most satisfactory. These are finished to size by grinding with diamond wheels and hand polishing with diamond dust. A complete check of tool wear and maintenance practice, and constant inspection of finished material, have proved that this is sound practice.

Thus, wherever it can be used, tungsten carbide tools have been found to offer the greatest resistance to wear in producing accurate tubing economically. But even tungsten carbide must be given proper lubrication attention, for high accuracy is impossible if tools change from the beginning to the end of a production run. If mineral base lubricants are used, sulphur content is vital. With water soluble lubricants, staining is a major problem. In either case, proper cleansing methods must be devised.

It can be seen, therefore, that in Precision Tubing production, there can be no makeshift tooling practices. Tools must be checked to make certain they are in perfect condition with duplicates ready if needed. There are no short cuts to quality.

Instruments THE MAGAZINE OF Measurement and Control

M. F. BEHAR, Editor

Instrument Men Are GOOD Men

IN the City of Brotherly Love, during four mid-September days and evenings, nearly thirteen thousand brothers passed through the doors of the Municipal Auditorium (better known as Convention Hall) to attend two-score technical meetings and to view an industrial and scientific exposition, "The 1948 Instrument Fair," of the Instrument Society of America.

They were all brothers in one great fraternity composed of skilled and unskilled men, of white-haired veterans and beardless novices, of vendors and buyers, of employers and employees, of teachers and students, of theorists and mechanics, of scientists and salesmen . . . composed in large part of members of well-run societies but itself unorganized and practically unorganizable — itself unnamed and probably unnameable because no short name could cover all the categories of brothers and at the same time make it clear that musical and other dictionary-defined instruments are not involved; because the only accurate name would be a description of the great brotherhood, along the lines of the one which first appeared on this page in 1933:

"All men who conceive, invent, design, develop, build, sell, specify, apply, install, service and maintain measuring instruments, meters, gages, testers, counters, totalizers, automatic controllers, automatic analyzers, automatic inspection devices and all their related equipment and accessories . . ."

Even this rather lengthy definition seems incomplete today because today, after attending the conference at Philadelphia, one is convinced that two important categories should officially be added as true members of the great brotherhood:

1. "All WOMEN who . . . (etc. as above)."
2. "All who, though not designers, sellers, users, (etc.), are keenly interested in measuring instruments, controllers, (etc.), for professional, educational or business reasons."

Women's contributions to the instrument field had not been overlooked by *Instruments*. Many honorable mentions will be found in a number of issues. In April 1937 we featured the largely-feminine Good Housekeeping Institute Laboratory. Mrs. Alice ("Pat") O'Hara, spectrographic analyst at General Electric, was shown in action on our July 1941 cover; her story was printed in that issue and there was an editorial mention. And our January 1942 Special Issue included a special feature on the importance of female "Instrument Men" in war production as well as in laboratory work. But there seemed to be a larger percentage of women at the Philadelphia conference than there had been at Pittsburgh in 1946 and at Chicago in 1947. So, from now on, the expression "Instrument Men" should be understood as including both sexes.

As for "Instrument Men" who do not actually manipulate instruments but whose occupations call for a keen interest in instruments, until last July there was given them, in the columns of *Instruments*, only a small part of the credit they deserve. Last July, the title of this page was "'Big Industry' Prizes Your Know-how" and the occasion, as mentioned, was that "a Wall Street leader accepted the ISA's invitation to be its 1948 banquet speaker." From now on, the expression "Instrument Men" should be understood as including non-technical men keenly and genuinely interested in instruments.

Thus the thirteen thousand Instrument Men at the Conference and Exhibit included relatively many women and non-technical people — a few hundred women instrumenticians and a few hundred non-technical people.

The majority were "Users"—those who specify, apply, install, service and maintain instruments—those whom *Instruments* serves. Geographically, the largest group came from the Philadelphia-Camden-Wilmington district, as had been expected. Their number topped expectations—and so did the number of those who came from the rest of the world and crowded all Philadelphia hotels. But enough of statistics: Special Correspondent H. L. Hildenbrand will no doubt include them in his report. We prefer to treat the theme suggested by Philadelphia, the City of Brotherly Love.

As the members of the great brotherhood entered the main hall of the building to view the many exhibits, they saw above the stage at the far end an impressive sign which read

INSTRUMENTS
MAKE FOR A BETTER WORLD

and some of them, no doubt, said to themselves when they saw it that the committee in charge had used one of the most effective of the ideas published repeatedly in the last fifteen years. But things—as things—cannot improve or worsen the world. Men and women can. This is the essence of the truth behind many of the similar sayings—that "books" or "schools" (schoolhouses) or "churches" (buildings)

or "hospitals" or "paintings" or "sculptures" or "good roads and automobiles" or "airports and airplanes" or "machine tools" or "telephones" (or electric refrigerators and other widely-advertised gadgets) make for a better world. Literally, such sayings are neither demonstrable nor refutable; figuratively, most of them contain verifiable and never-to-be-forgotten truths. To your editor, the big sign dominating the vast hall did not mean that gages and regulators make for a better world; it meant that

INSTRUMENT MEN
MAKE FOR A BETTER WORLD

and it implied that not only the thirteen thousand participants, but their tens of thousands of fellow-members in the great unorganizable brotherhood who did not attend, make for a better world.

* * *

Such were the ideas that came to mind at first sight of the big sign. But one found oneself in entire agreement with the actual wording—for the implicit wording (Instrument Men Make for a Better World) would undoubtedly have made some Instrument Men—a small minority—feel uncomfortably self-conscious. And, among the vast majority of participating and visiting Instrument Men, each individual would never for a moment have imagined that the flattering motto applied to him.

* * *

That's one of the finest traits of the Instrument Man: if he is told that he is making the world better, he will stare in amazement and mutter something like "Who, ME?"

* * *

Yes, you!

If you design, build, sell, specify, buy, install or maintain instruments and their accessories, you are making the world better . . . and it is high time that you should know this fact of modern life.

If you advance Instrumentation in the course of your educational work, you, too, are making the world better.

If you promote the growth of Instrumentation by your decisions as an industrial executive, you are an Instrument Man and as such you are making the world better.

If, although you are not a technical man and never think of yourself as an Instrument Man, you promote the growth of Instrumentation by your own investments, by influencing other investments, etc., then you, too, are making the world better, and you deserve the honorable designation of Instrument Man.

* * *

Toward the end of the Conference these two dominant ideas—that Instrument Men make for a better world and that their total number is at least twice the number of instrument specialists—became so vivid that they were voiced to congenial fellows on an impromptu convivial occasion.

To report that these two ideas met unanimous approval would be exaggerating. The atmosphere conduced neither to expository discourse nor to attentive listening.

The friendly opposition did not mince words:

Said one Instrument Man: "That big sign is just plain ballyhoo . . . No, it's not untrue, but it's only a half-truth because instruments also make for a worse world. For instance, instruments used by safe-crackers or counterfeiters . . ."

Another critic broke in: "And bombing-plane instruments; and all the instruments on battleships and submarines and tanks. Do they make for a better world?"

The obvious reply was the same for both arguments—to the effect that policemen's instruments prevail over criminals' instruments and that the war instruments of the world's free nations are likewise law-enforcement instruments, used only against aggressors, so that ON THE WHOLE, even instruments pertaining to engines of death and destruction make for a better world.

"But," we continued, "the wording of the big sign is not under discussion although it was mentioned at the start; the two specific ideas proposed for discussion were that Instrument Men make for a better world and that many people other than us specialists are Instrument Men."

To the first idea, the chief objection was that there will always be some Instrument Men misguided and misled on the side of the devil—not only in international relations but in legal, economic and other quarrels within our own nation.

Strong objections met the second idea. Said one idealist: "How about a no-good boss who okays the instrumentation of his plant and then spends the extra profits on a fourth wife and fifth yacht? Would you call him an Instrument Man? . . . Sure, that's an exaggeration, but how about the character who okays instrumentation for no other reason than to cut down his payroll, not only to fatten his immediate profits—which is ethical enough—but to throw men out of work and bring back the good old days? . . . No, I'm not talking politics and I'm not a union man but I'm telling you that a lot of mean cusses scheme and work to create a so-called reservoir of labor which means a pool of ten million unemployed workers."

To this, the reply was that Instrumentation benefits both capital and labor. It is true that the nineteenth century and the beginning of the twentieth witnessed a series of sudden impacts of revolutionary labor-saving inventions, each throwing men out of work. Instrumentation is different: Its introduction is not an impact but an influence; its result is not technological unemployment but technological displacement always in the sense of UPGRADING; and it actually CREATES employment.* The Machine Age was not free from evils but the dawning Age of Instruments is making technology a pure blessing.

The objections to our generalizations gladdened us, for they showed a critical sense of values and a modesty and conscientiousness possessed by most Instrument Men.

* * *

FRANK TOTTON.

The banquet was a sell-out. Late-comers were out of luck. No doubt, many who crowded the hotel ballroom must have been drawn by curiosity: to hear a Chase National Bank Vice-president discuss their highly-specialized work. The announced title of his talk was "America Tomorrow" and some diners expected carefully-drawn forecasts based on statistics of industrial trends, together with prudent advice on diversification, etc.

Never shall we forget the refreshing surprise to which we were treated. Frank Totton had the audience in the hollow of his hand from the start to the climax and peroration. He made us alternately laugh and almost weep. His only references to banking were in his side-splitting witticisms; many of these jokes were on bankers—sometimes on himself. "America Tomorrow" was a sermon—all the more effective for not being a pulpit-style preachment—a simple talk on the brotherhood practiced by America's founding fathers and by our own fathers—stories of democracy in action, their heroes mostly of humble birth and of all races, religions and national origins. The longest story he told was that of Dr. George Washington Carver. Moreover, the only time Totton cited statistics was in relating Dr. Carver's many-sided achievements—and the way he rattled off columns of figures by heart—figures on Southern industries created by the famous son of an unknown slave—made mathematicians admire him. When he had concluded, only a stone-hearted bigot or vicious hate-monger would have failed to resolve to make America's tomorrow brighter by practicing the brotherhood of man—by helping unite America's diverse components more and more firmly and combatting those who would divide classes, races, religions or national origins. The applause was the most enthusiastic we ever heard at any technical-society meeting.

*See editorials in these issues: Oct. 1933; Jan., May & Nov. 1934; Dec. 1935; May 1937; July 1938; Jan. 1939; Jan. 1940; Apr. & Dec. 1944; Apr. 1946.

SHELL OIL'S TOP MANAGEMENT.

Of the many kinds of men to be found among the officers of large corporations, there is the kind that remains instrument-blind. Their numbers dwindle and their influence wanes, but they still exist.

At the other extreme—the happy extreme—are the officers who are not only fully awake and alert to Instrumentation's possibilities but who take a sympathetic and cordial interest in their Instrument Men—without a trace of condescension or paternalism—and who manifest this friendly interest by their policies and by their actions.

What better example of policies and actions than to have Instrument Men from the company's scattered plants and labs go to an ISA conference and remain together several days afterward for an "idea conference" of their own?

Shell is one of the happy companies blessed with such managerial vision. Here are a few details:

The group that attended the technical sessions and visited the exhibits Monday through Friday, then held its own conference, is known as the Measurement and Control Committee. J. G. Kerley is Chairman. Its duty, of course, is to promote the use of measurement and control equipment . . . with emphasis on new equipment. Its twenty-five members are all engineers but some are not instrument specialists. Its main purpose may be called "application research rather than formal research."

Each Committeeman is a REPRESENTATIVE of a "plant" or "department" or "pipe-line" or "affiliated company" (perhaps other terms escape our memory), all the way from exploration and production to final "marketing engineering." There were also "Visitors" from Canada, from Holland and from Curaçao. Each Representative has organized a similar group in his own plant (or "Department," etc.). Each such group is headed by an Instrument Engineer and includes representatives of management, of laboratories, of technological departments and of operating departments.

The Committee was instituted by Shell's top management in 1945. At first it met quarterly; then annually. This was to be its eighth plenary meeting. Various subcommittees were to meet Saturday; the main meetings were to be held the following Monday through Wednesday. Thus some men spent nearly two weeks in Philadelphia. Ample hotel accommodations had long been reserved.

All expenses paid? Certainly! "Convention" atmosphere? Certainly NOT! No participants we saw at Philadelphia kept busier than the Shell men: they seemed to be on active duty twenty-four hours a day!

* * *

DISTINGUISHED SERVICE

Those who toiled to make the Conference and Exhibit cannot be praised too highly. The greatest amount of work was done, of course by the Philadelphia Section committees and by National Society Committees in various cities. Again we single out the Educational Committee; and we express admiration for its Chairman, Professor E. D. Wilson (who, when presiding, looks and acts like the Board Chairman of a great corporation). We particularly enjoyed this year's new feature, the Early Birds Breakfast each morning and the informal talks which followed. Congratulations to Chairmen Hall, Ladden, Mason and Heller, as well as to speakers Jones, Thomas, Monk and Hartung.

* * *

FRIENDLY NEIGHBORS AT EXHIBIT

"You will see some of your best friends in the pictures on the next four pages. Some are your fellow instrument users; others are instrument-company people . . . ." So ran our opening words a year ago. The rest of that editorial introduction is equally applicable this time. But this year you will notice (if you are well-acquainted) people from Company A in Company B's booth; B people in A's and C's booths; and so on. Never did we see so much visiting—and by jolly good friends from rival companies making the same lines. But perhaps this was the first year we noticed (in the City of Brotherly Love) that the mutual esteem of user and maker prevails also among makers.

"Instruments Make for a Better World."

"Instrument Men Make for a Better World."

Yes—because Instrument Men are GOOD men in the meaning of "good" as understood by our fathers—as meant to be understood when one reads the Holy Bible. —MFB

PHOTOGRAPHS OF THE 1948 CONFERENCE AND EXHIBIT OF THE INSTRUMENT SOCIETY OF AMERICA

Altogether more than five pages: on the following four pages, fifty-four photographs taken on the main floor (instrument companies' exhibits); on pages 903, 905, 910 and 911, other photographs taken elsewhere.

WELCOME
DAVIS
CONOFLOW CORPORATION
DISTILLATION PRODUCTS, INC.
HIGH VACUUM GAUGES
A. W. CRAMER CO.
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KANIA REGULATO
SIDIARY OF GENERAL PRECITION EQUIPMENT
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MANUFACTURERS FOR
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INSTRUMENT COMPANY
STREETER AMET CO.
PERMOPIVOT
MOORE PRODUCTS CO.
SPEED
HAGAN
HAGAN

Best-attended technical session was demonstration of modes of control by Akins and Kowalski.

Highlights *of the* 1948 Conference

By *Instruments*' Special Correspondent **H. L. HILDENBRAND** (Editor of the *Journal* of the ISA)

IN Philadelphia, September 13-17, 1948, the Instrument Society of America proved that it has grown up. From the first Conference in Pittsburgh two years ago, with a total registration of 3000, through 7000 at Chicago in 1947, we reached the astounding total of 12,915 at Philadelphia. Certainly, every ISA member has reason to be proud of that achievement and all of us who were there—members and non-members alike—owe a debt of gratitude to the Philadelphia Meetings Committee headed by E. J. Grace and the Papers Committee headed by Lyman Allen for a fine job.

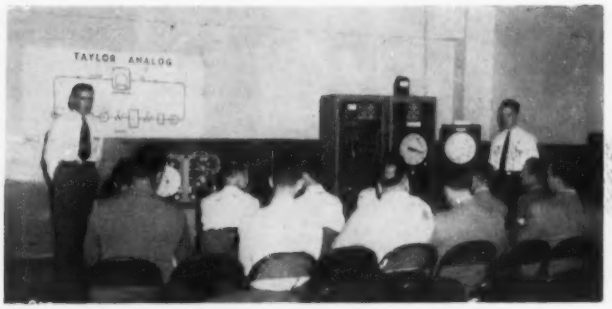
By days the registration was as follows:

Sunday, Sept. 12	804
Monday, Sept. 13	2643
Tuesday, Sept. 14	2626
Wednesday, Sept. 15	1629
Thursday, Sept. 16	3885
Friday, Sept. 17	1091
Grand total	12915

A geographical and occupational breakdown of this attendance will be passed on in the ISA Journal columns of *Instruments* as soon as it is available. Coöperating with the ISA were the American Society of Mechanical Engineers, the American Institute of Physics and the American Institute of Electrical Engineers. In addition, the Scientific Apparatus Makers of America held a luncheon on Wednesday, Sept. 15th for its members and exhibitors' representatives. The combined offering of the participating associations totalled 39 papers. Eighteen of those were ISA papers, most of which will be published in the Journal as space permits.

In addition to the technical sessions, there were eight educational lectures which were well attended. These ran both morning and afternoon from Tues-

By *Instruments* Cartoonist Phil Putnam



ANALOGS—Two small rooms off the main hall were used for demonstrations of automatic-control analogs. *(Left)* George A. Philbrick Researchers, Inc.; Foxboro Co.; Reeves Instrument Co. *(Right)* Taylor Instrument Companies; Brown Instrument Co.

day to Friday, inclusive. Movies on measurement and control were shown Tuesday, Wednesday and Thursday afternoons in the ballroom.

All of the technical sessions were well attended and it was found necessary to move some of the sessions to larger quarters. On Monday morning, the first ISA session on Ordnance Instruments convened in a room with seats for 250. There were soon about 300 in the room and many more in the hall were turned away. The afternoon session was the same so beginning on Tuesday, these sessions moved to ample quarters in the basement. (Incidentally, the larger quarters were also cooler). The high spot of the week was again the talk and demonstration by Gerald F. Akins and John Kowalski of Eastman Kodak Company on "Automatic Control Principles." The huge ballroom was full for this evening meeting. The second largest attendance was for the lecture, "Looking into the Future of Electronics," by Gordon Volkenant. Those who came to be instructed found instead that this was pure entertainment and were warned at the start not to check too closely on technical accuracy.

The third evening lecture on "Science in Crime Detection" did not draw quite as large an attendance although it was an interesting and informative talk.

The banquet on Wednesday evening, Sept. 15th, drew 506 members and guests. Officials of the ISA and participating Societies occupied the speaker's table. Opening remarks were made by E. J. Grace, who turned the chair over to retiring president Paul Exline, who introduced the officers of all societies. The speaker of the evening, Mr. Frank Totton, Vice-president, Chase National Bank, talked on "America Tomorrow." To say that this was different from the usual banquet speech is putting it mildly. His faith in the future was an inspiration to all who heard him.

Following the talk, Executive Secretary Richard Rimbach presented charters to the new sections as follows:

Section	*Charter No.*	*Dated*
Richland	35	Jan. 1, 1948
Rochester	36	Feb. 16, 1948
Cent. Illinois	37	Mar. 8, 1948
Houston	38	Mar. 16, 1948
Montreal	39	June 16, 1948
Akron	40	July 19, 1948
Boston	41	July 28, 1948
Atlanta	42	Aug. 23, 1948

The new officers and executive committee were then introduced and the gavel presented to the new president, Carl F. Kayan. No mention was made of the fact at the banquet but the gavel was a gift to the ISA by M. S. Jacobs of the Pittsburgh Section. President Kayan closed the meeting with a rising vote of thanks to the officers and committee members who had made possible the past year's progress.

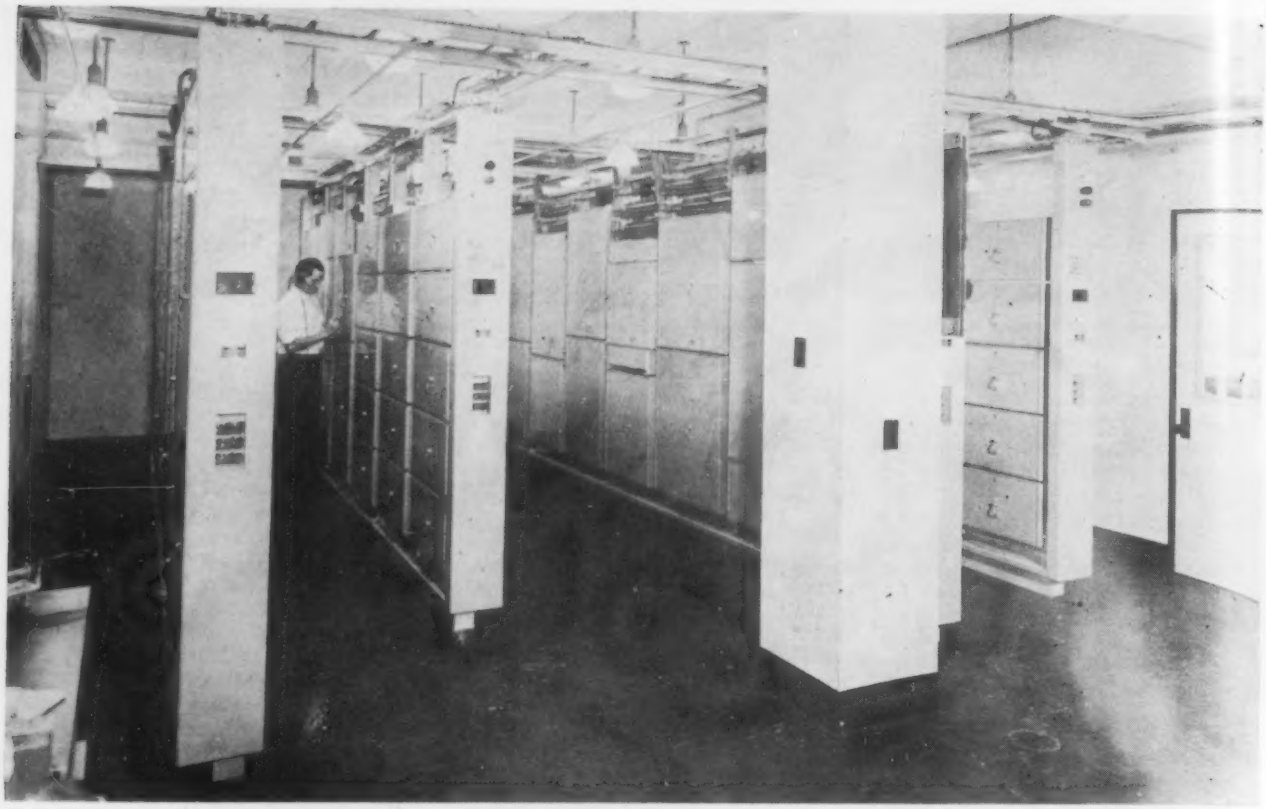
The exhibit was again worth the $10.00 annual dues, if the member received no other benefits from attending the conference. There were 200 booths, totalling 22,022 square feet of exhibit space, occupied by 158 exhibitors. While many of the products exhibited were not new, it was still worth while to see all of them gathered together in one place. A number of comments were heard about two or three technical sessions and the exhibit running at the same time. Yet on the days when only one technical session was going, the attendance was no larger than it had been when two or three were in session. This would seem to indicate that there is no disadvantage in having several sessions running simultaneously. Apparently those desiring to hear more than one paper were dividing their time between sessions, or obtaining preprints or both. The Early Birds' breakfasts, held at 8:30 A.M. Tuesday to Friday, inclusive, attracted varying numbers. After breakfast each morning a paper was presented and we hope to pass some of them on in the Journal columns.

Practically all week, committees were meeting to work on ISA affairs. An attempt was made by the writer to spend a little time in each technical session, educational session and committee meeting. It was not 100% successful as some committee meetings were missed because of the variety of things going on at one time.

It is hard to see now just how the 1949 Conference can improve upon this one, but committees are already well along with that work. Plan now to be in St. Louis in 1949. You won't be disappointed.

HEIGH HO! WE GO TO THE FAIR!
HI JOE! YEAH, I JUST GOT HERE. THIS YEAR I'M DOING IT RIGHT-A FEW PAPERS TO HEAR AND CAREFUL STUDY OF EXHIBITS!
DATE WITH JOE-GOOD CUSTOMER-MUST KEEP IT
MEET TH' WIFE!
LUNCH WITH TH' BIG BOSS
I.S.A. 2:00 P.M ROOM 201
A.I.E.E. 2:00 P.M BASEMENT
ASM 2:00 P.M ROOM 300
IT REALLY WAS A WONDERFUL FAIR! DON'T MISS ST. LOUIS IN 1949!
PAE-PAINT #1061!!!

By *Instruments* Cartoonist Phil Putnam



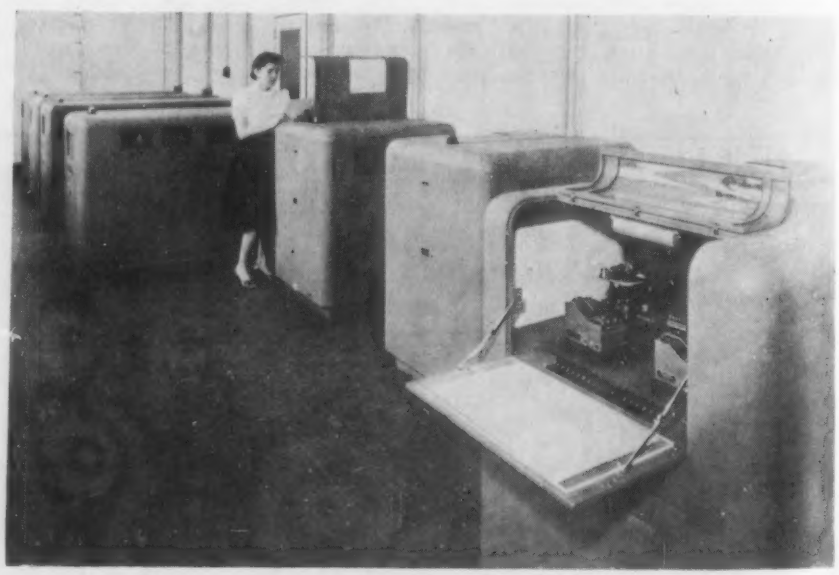
The Bell Relay Computer. In this view are shown the racks in which the computing, storing and controlling relays are mounted. Through the door may be seen one of the input devices shown in another photograph.

The Bell Relay Computer

By FRANZ L. ALT, Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland

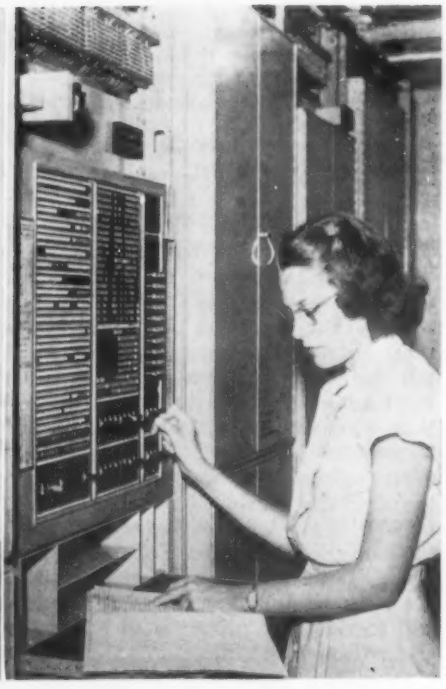
THE outbreak of the last war created an enormous demand for research work in all fields of science, most of which had to be completed at the earliest possible time. This in turn brought about a huge volume of computations which had to be carried out in order to assist scientists in their work. Whatever computing equipment was available at the beginning of the war—desk type computers, punch card machines and even the most advanced device at the time, the Bush Differential Analyzer—was soon loaded up to capacity with computational problems, and along with them an army of human computers strove to accomplish its task. Faced with this situation the Ordnance Department sponsored the development of several high-speed computing devices for the Ballistic Research Laboratories at the Aberdeen Proving Ground.

It was realized early in the program that entirely new methods for storing and handling numbers were called for. Thus, the approach selected differed from that of the Massachusetts Institute of Technology, which modernized its differential analyzer and made it into the best continuous-variable machine now in existence, and from that of the International Business Machines Corporation whose Automatic Sequence-controlled Calculator at Harvard, although unprecedented in size, was based for the most part on the application of existing computing techniques. Instead, two entirely new principles of computation were developed under the auspices of the Ballistic Research Laboratories. One of these was the use of vacuum tubes for computation. The result of this development was the construction of the ENIAC which was undertaken by the Moore School of Electrical Engineering in Philadelphia and was completed in the



Input, output and control devices. Tape processor in foreground, two recorder tables in center and four input tables in background.

Power supply control panel, showing indicating instruments and connector switches for the other components of the Bell Relay Computer.



Control panel for manually inserting orders in the Bell Relay Computer.

fall of 1945. The great advantage of the scheme lies in the fact that vacuum tubes will respond to very high pulse rates—100,000 per second or more. Computation can thus be carried out extremely fast. Millions of multiplications, for example, can be performed in an hour.

The other new principle was the use of relays. Simultaneously with the construction of the ENIAC, another machine was developed for the Ballistic Research Laboratories by the Bell Telephone Laboratories in New York. Where the ENIAC used vacuum tubes to represent numbers, the latter machine uses relays of the same kind as are used in telephone exchanges. The idea of using relays for computation is due to George R. Stibitz, and the machine built at the Bell Telephone Laboratories is sometimes briefly called the Stibitz machine. It is easy to see that relays can be electrically connected to represent and manipulate numbers in the same way as was done with vacuum tubes in the ENIAC. In fact, the use of relays brings with it a number of simplifications as compared with tubes. On the other hand, the rate of operation of relays is several hundred times slower than that of vacuum tubes.

As a result the Stibitz machine is *relatively* slow. It performs a multiplication in approximately a second. On the other hand, it is a great deal more flexible than the ENIAC. Since relay circuits can be designed more efficiently and with greater complexity than electronic circuits, the Stibitz machine is able to perform very complicated operations. As in most digital machines, the basic operations which the machine performs are only those of addition, subtraction, multiplication, division, and extractions of square roots. But the machine can be instructed in advance to perform a long sequence of such operations.

It can also be instructed to choose between alternative courses of action. Some of the most frequent, but by no means the most complicated, choices which the machine will perform, are these:

If a problem has to be solved by a process of repeated "trial and error," the machine will keep on repeating until it has come close enough to the solution of the problem, and then automatically print the answer and go on to the next problem.

If too many trials are required, the machine may be instructed not to attempt more than, say, five, and if by that time it has not found a solution, it will attempt a different procedure. Also if several problems in succession have been solved at the first trial, the method used is presumably too good, i.e., a simpler and faster method may be used. The machine may be instructed to switch to such a method in this event. The machine is designed to operate at night without requiring the presence of a human operator. If, during unattended hours, a trouble occurs —this may be either a failure of some part of the machine or an error of the operator who had previously set the machine up for a particular problem— the machine will wait a short time to see if the trouble clears up and will then automatically discontinue all computations on the present problem, and immediately start work on any other problem that has been prepared for it.

In several respects this machine is superior to all existing machines of its size. One is its perfect reliability. During the entire period of its operation, this machine has never given a wrong answer (except when a machine operator, by mistake, asked the wrong question.) It contains an elaborate network of check circuits which cause the machine to stop immediately in case of trouble, rather than permit it to go on with a computation which might be wrong. When it stops, lights flash on and indicate to the maintenance personnel the nature of the trouble. This indication is so complete that, despite the enormous complexity of the machine, the trouble is usually spotted and removed in a matter of minutes. This speed of trouble-shooting is unmatched by any other computing machine.

Another important feature is the ease with which the machine can be set up to do any desired new computation. All instructions to the machine, together with the numbers with which the computation is to begin, are coded in the form of holes punched in paper tapes. Up to twelve tapes are used for one problem. These are prepared by the machine operator and loaded into a "position table" where they wait until the machine has finished the problem on which it is working at the time. At that point the machine automatically connects itself to the waiting position table and starts work on the new problem, without wasting a second's time.

Among the problems which have been solved successfully on this machine are equations describing the flight of bombs and guided missiles, the flow of heat in burning or melting substances, computations in mathematical statistics and numerous others, each of which would have taken years of work by ordinary computing methods.

Continuous Oscillograph Camera *for* Ionosphere Measurements

By JAMES E. HACKE, Jr., Department of Electrical Engineering, The Pennsylvania State College, State College, Penna.

A FIXED-FREQUENCY pulsed transmitter is often used in routine measurement of ionosphere reflection characteristics. Operating in the band between 1 and 15 Mc., it emits short bursts of r-f. energy, which are reflected at one or more layers in the ionosphere and return to earth after a time delay proportional to the distance they travel.

If the output of a special receiver tuned to the transmitter frequency be applied to the vertical plates of a cathode-ray oscillograph, and a linear time base to the horizontal, position of the returned pulses on the CRO screen will therefore be proportional to effective reflection height.

To record these data permanently, the screen of the CRO tube is masked, except for a narrow slit exposing the base line of the oscillogram, and the slit photographed on moving photographic paper. The resulting record shows unexposed traces corresponding in position on the record to delay time and hence to reflection height.

The camera described for taking these records has several advantages which may make it adaptable for other uses. It is relatively simple in construction; most of the drive mechanism is comprised of stock parts, and the resulting camera is rugged and relatively foolproof. It needs loading and oiling but once a week, and may be used in a lighted room.

Housing.—A side view of the assembled camera is given in Fig. 1. Its main body, about 12″ × 14″ in plan and 18″ in height, is built of ½″ plywood glued and screwed together, and lacquered after assembly. The metal tube on the front fits against the CRO tube. In use, a strip of black felt is wound around the front end of the metal tube and held in place with a rubber band; when this is forced against the CRO tube, it prevents external light from entering the camera.

As Fig. 2 shows, the back of the camera is removable for adjustment and loading. It is held in place by four wing nuts. A felt strip glued around the edges of the back serves to keep out extraneous light.

The internal framework visible in Fig. 2 is constructed of ¼″ thick brass plate. The motor and gear box, in the lower half of the camera, are mounted on a plate screwed to the base of the camera; the paper drive mechanism, in the upper half of the camera, is built on an open frame fastened to the top and sides of the camera.

Motor.—Power to operate the camera is supplied by a 110-v. 1/100-hp. split-phase induction motor running off the 60-cycle mains. Under light load conditions, this motor may be considered synchronous at its rated speed of 1800 r.p.m. The motor is connected to the line through a male receptacle, sealed against light with friction tape. The motor is coupled to the gear box through a flexible coupling made in the shop. This consists of two brass disks, one each on the driving and the driven shafts, with a leather disk between them. Coupling between disks is by pins, set in the driving disk, which engage holes in the driven disk.

Gear Box.—Two stages of worm-gear speed reduction reduce the angular speed from 1800 r.p.m. to 15, 30, or 60 r.p.h., depending on a set of interchangeable spur gears between the two worm-gear stages. Each worm-gear stage consists of a single-spiral worm screw driving a 60-tooth worm gear.

The interchangeable gears are standard 48-pitch spur gears mounted on shafts 1½″ apart; the pitch diameters of any two gears used in combination add up to 3″. The gears are fastened to their shafts with nuts, and made to turn with their shafts by pins, in collars on the shafts, which engage holes in the gears. Four gears in all give a choice of three speeds. Two equal gears give a final paper speed of about 3″ per hour; two gears, one of 1″ and one of 2″ pitch diameter, give speeds of 1.5″ or 6″ per hour, depending on which is used as the driving gear.

The first worm gear is lubricated by an oil line leading to a reservoir outside the camera. An ordinary pipe cleaner in the tube leading from reservoir to gear keeps the oil flow down to two drops per hour.

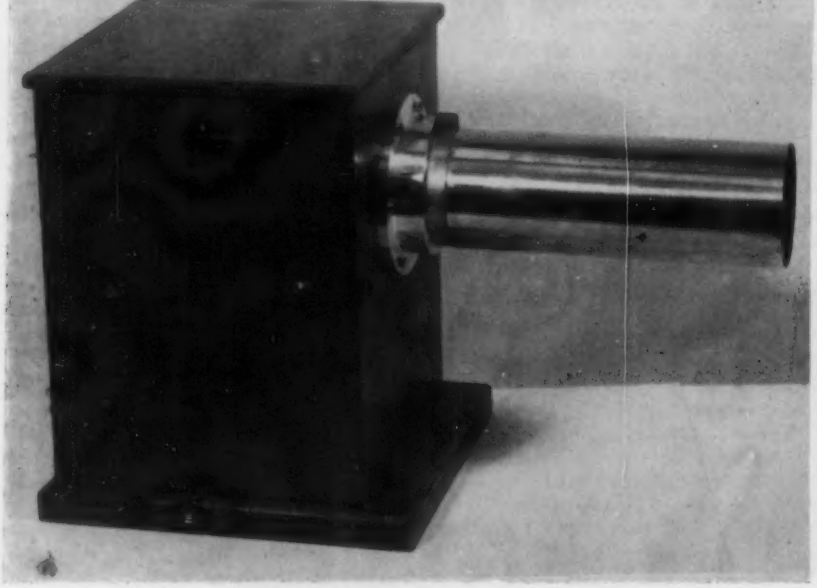


Fig. 1. Right side of assembled camera.

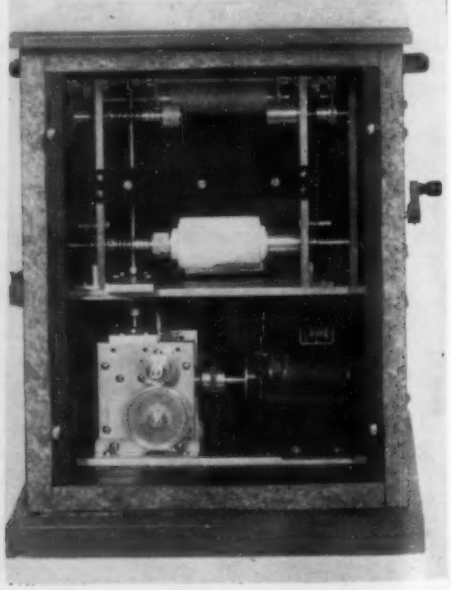


Fig. 2. Rear view of camera with back removed.

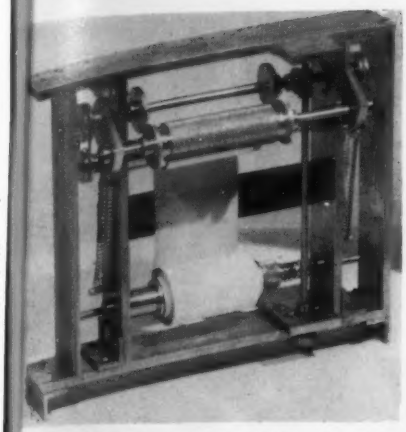


Fig. 3. Front view of paper-drive mechanism.

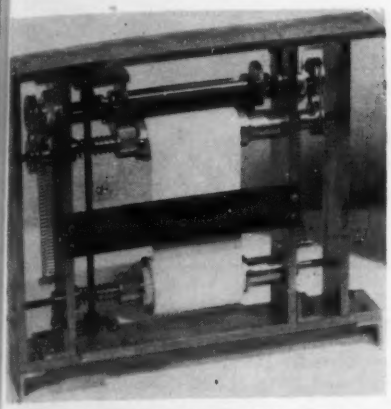


Fig. 4. Rear view of paper-drive mechanism.

All shafts in the gear box are mounted on ball bearings inserted in the sides of the box.

Paper Drive.—The paper drive mechanism is shown in Figs. 3 and 4. The photographic paper is loaded on the lower spool, and is wound by the drive mechanism on the upper spool. The Bakelite block in the focal plane, visible in the figures, has been replaced with one of Lucite for ease in focusing.

Fig. 4 shows the mechanism used to drive the paper at constant speed onto the take-up spool. A knurled drive roller bears against the paper on the take-up spool; it is held against the paper on the spool by two springs. This drive roller is turned by two gears, one on each end, which mesh with identical spur gears on a shaft passing parallel to the take-up spool shaft and above it. This shaft carries a 30-tooth worm gear which meshes with a single-spiral worm screw on the vertical drive shaft visible in Figs. 2, 3, and 4. This shaft is driven by the output shaft of the gear box, and is coupled to it by a flexible coupling similar to the one between motor and gear box.

The let-out spools and take-up spools are demountable for loading and unloading. Each end of the spool carries a short length of ⅛" brass rod, which fits in a hole in a chuck. The left chuck is movable, and is forced against the spool by a spring, bearing against a collar on the shaft. Small vee pulleys, mounted on the horizontal driveshaft and on the take-up spool shaft, insure that the take-up spool will turn with the paper. These pulleys are coupled by rubber bands.

Optical System.—The lens is a simple magnifying glass of 5" focal length. As originally mounted, it had an aperture of 1½", corresponding to a speed of *f*/3.3. This was much too fast, however, and it was found necessary to reduce the speed to *f*/40 by an iris to obtain good results. At this aperture, and with the small convergence of this lens, no chromatic or spherical aberration is noted.

The camera is moved the proper distance from the CRO screen to obtain sharp focus. The sliding metal tube on the front is then moved in place against the CRO screen, and locked by a clamp similar to a pipe clamp.

The camera uses Eastman "Linagraph" extra-thin orthochromatic bromide paper, which comes in unpunched rolls 2½" wide and 250 ft. long.

The shutter consists of a metal disk 2" in diameter which bears against a felt edge around the lens aperture. It is mounted on a radius rod which moves it down and away from the aperture when the recorder is in use. The crank for operating the shutter is visible in Fig. 2. An eccentric weight on the control shaft provides positive positioning.

Results

Fig. 5 is a sample half-hour record taken on paper moving at six inches per hour. Time increases horizontally from left to right, and equivalent height increases vertically upward. Time marks consist of one-minute intervals, occurring every fifteen minutes, during which the receiver is disconnected and vertical height marker signals are impressed across the oscilloscope. These appear on the left and right margins and in the center of the photograph. The height markers appear as unexposed lines which are separated by an equivalent height of 50 km. By further using the height marking pips for *Z*-axis modulation of the oscilloscope, the dark lines forming a grid on the photograph provide vertical height coördinates during the signal-recording intervals.

The unexposed strip near the bottom of the record, about 100 km. wide and "blanking" one of the 50-km. height markers, is produced by the transmitted pulse. Just above it at a height of approximately 120 km. is some evidence of sporadic E-layer reflection. The most prominent reflection, corresponding to the unexposed strip at a height of about 600 km., is due to the F-2 ionosphere layer. Some F-1 reflections appear below this. Double-hop F-2 reflections are indicated on the original record.

Acknowledgments.—This camera was developed for research being carried on by The Pennsylvania State College under Contract W28-099-ac-143 with Watson Laboratories, Air Matériel Command, United States Army, Red Bank, N. J. Most of the actual fabrication of the camera took place in the Electrical Engineering shop under direction of Professor G. L. Crossley. The many hours he spent on design, drawings, and shop supervision contributed materially to the usefulness of the camera. Many design features of the camera are results of conferences with research personnel of the Electrical Engineering Department, notably Mr. P. G. Sulzer.

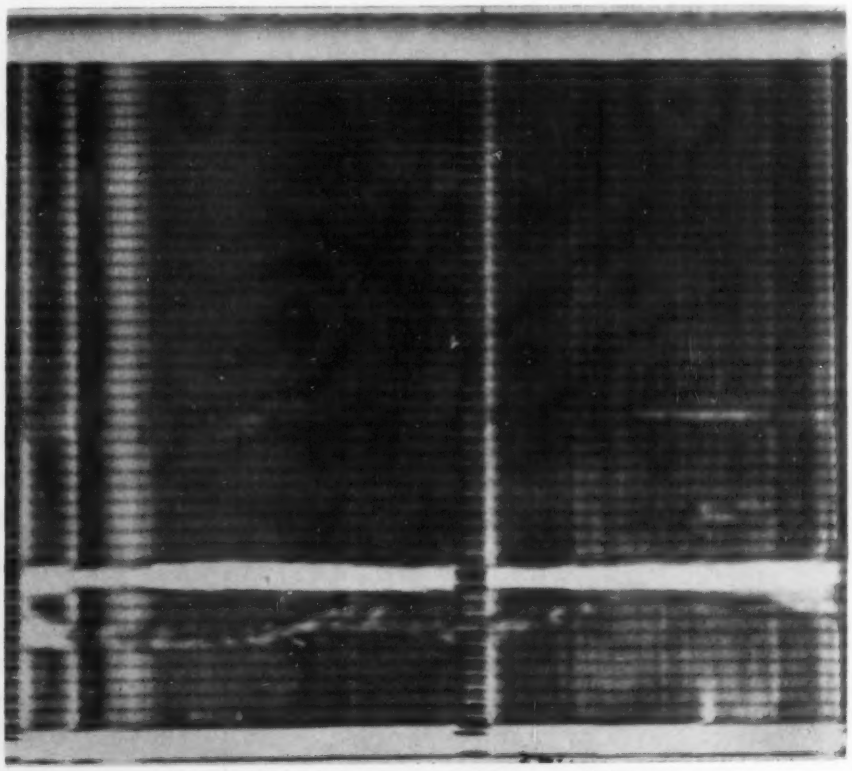


Fig. 5. Reproduction of camera record taken in mid-afternoon.

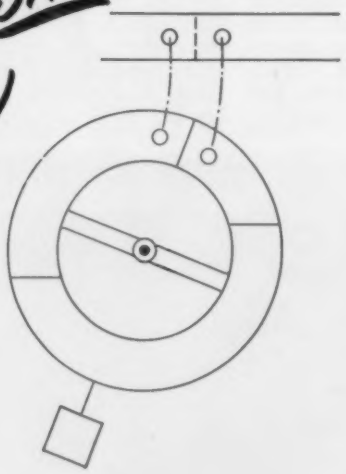
RING BALANCE METERS, SURE—

BUT BE SURE THEY ARE

HAGAN

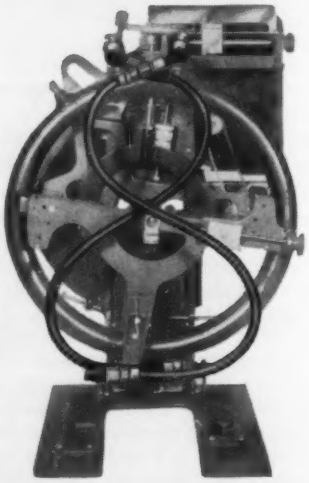
Ring Balance

this isn't new



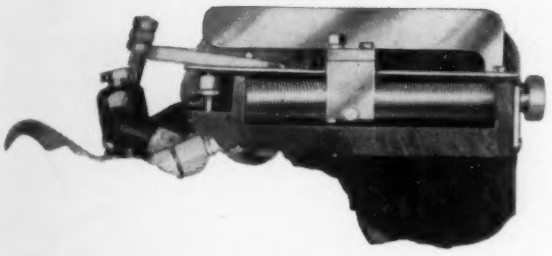
The ring balance principle is old, and flow meters based on this principle have been built both in this country and in Europe. But all of them, except the meter which Hagan now builds, had features which largely offset the advantages inherent in the ring balance principle.

this is new



One weakness of other ring balance type meters is that connecting lines, particularly when pressures are high, tend to restrict ring motion. In Hagan Ring Balance meters, this difficulty is completely eliminated in a most simple and direct fashion—by the use of S-shaped connecting tubes. This feature is patented, and is found only in these meters.

and this is new-



Adjustment of this spring by means of a simple range screw permits a change of as much as 7 to 1 in differential pressure. Even at low flows, this unique spring resistance system gives high accuracy in the conversion of differential head to pen movement. Patent is pending.

and so is this

The integrator, another patented feature of Hagan Ring Balance meters, is an independent unit easily added to or removed from a standard meter assembly. It is simple in design; accurate between 2% and 100% of meter range; calibrated by a single adjustment; and easily checked, either under test conditions or with the meter in service.

For full information on Hagan Ring Balance Flow Meters, write for Hagan Bulletin 2M48. Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

The Month's NEW INSTRUMENTS

In this department we report each month new devices for measurement, inspection, testing, metering and automatic control—in the form of concise technical descriptions.

FOR FURTHER INFORMATION USE THE POSTAGE-FREE ORDER CARD ON PAGE 963

Laboratory Rotameters

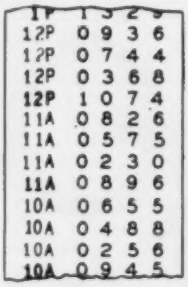
Two new inexpensive rotameters are said to "cover almost the complete range encountered in the laboratory." "Model G9146 Flometer" (8 mm. O.D., 9½" long) is for small flows and covers 30-900 cc/min. by using a steel and glass ball float in the same tube. "Model G9147 Flometer" (12 mm. O.D., 9½" long) is developed for larger flows and covers 1,000 to 38,000 cc/min. A calibration chart for air flow is supplied with each. Standard tapered joints are also available at small additional charge. — *Emil Greiner Co., 161 Sixth Ave., New York, N. Y.*

Please mention number **1001** when filling out card

Tape-recording Mechanical Counter

New "Recording Scientific Counter" has been developed for scientific and industrial applications. A continuous record of counts is maintained without attention of an operator. Instrument is well adapted for use in radiation

laboratories where danger of contamination exists or where data must be accumulated over a protracted period of time. Actuated by a high-impedance relay, counter may be used in connection with scaling charts, electronic timers, phototubes or other electrical signals. Number of counts is recorded on a 2¼" tape every fifteen minutes, with automatic reset to zero every hour. Upon request, certain changes in operation may be made. Other timing



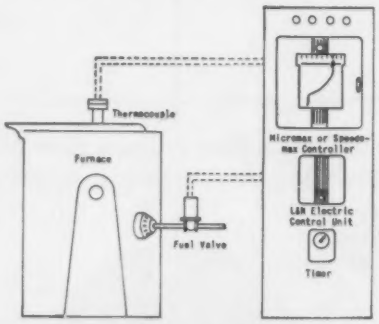
12P	0	9	3	6
12P	0	7	4	4
12P	0	3	6	8
12P	1	0	7	4
11A	0	8	2	6
11A	0	5	7	5
11A	0	2	3	0
11A	0	8	9	6
10A	0	6	5	5
10A	0	4	8	8
10A	0	2	5	6
10A	0	9	4	5

periods and special actuating devices may be provided when necessary. Standard counter operates on 110-volt 60-cycle current; other current characteristics available. Counter is solenoid-operated and will maintain a high sustained rate of count—well in excess of 1000 per minute.—*Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 3, Ill.*

Please mention number **1002** when filling out card

Aluminum-melting-furnace-temperature Control System

New modification of "Duration-adjusting Type of Electric Control" is for batch furnaces for melting aluminum: to bring them to temperature quickly and accurately without danger of overshooting. New equipment helps

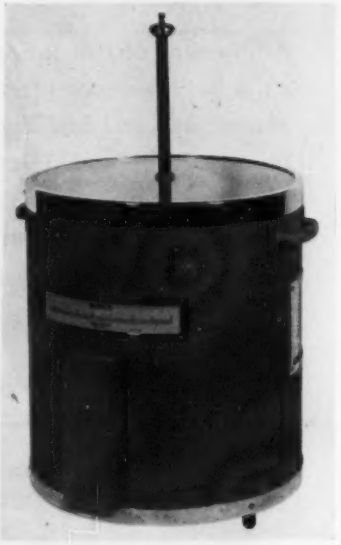


improve quality of castings by preventing gas inclusions and blowholes through limiting high-temperature swings. Furnaces can be brought to temperature safely at maximum heating rate. To avoid overshoot, "D.A.T. Controller" automatically turns off fuel supply at a predetermined point. If necessary it also holds charge accurately at pouring temperature as long as desired. Instead of throttling fuel valve, "D.A.T." alternately turns fuel from full on to full off. By controlling the durations of on-time, "D.A.T." supplies heat input needed to balance heat demand of furnace. In addition, the control instrument—a "Micromax" or "Speedomax" pyrometer—operates a set of lights which signal operator when fluxing and pouring temperature is reached.—*Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.*

Please mention number **1003** when filling out card

Electrostatic Voltmeter

New portable electrostatic voltmeter is a high-impedance, high-voltage instrument, available in five ratings from 40 to 75 kv., rms. Housed in a cylindrical steel case 21½" in diameter and 35" high, it weighs approximately 50 lbs. High-voltage connector projects about 12" above top of case. Moving system consists of two fixed electrodes between two small metal spheres that revolve on a pivoted shaft on which are mounted aluminum damping vanes, a mirror, and a spring. Mirror reflects a light beam on to scale, indicating position of the moving electrode. Moving system is insulated from case and is connected to high-voltage terminals



through a current-limiting resistor which serves as a protective device when voltages in excess of flashover values are accidentally applied.—*General Electric, Schenectady 5, N. Y.*

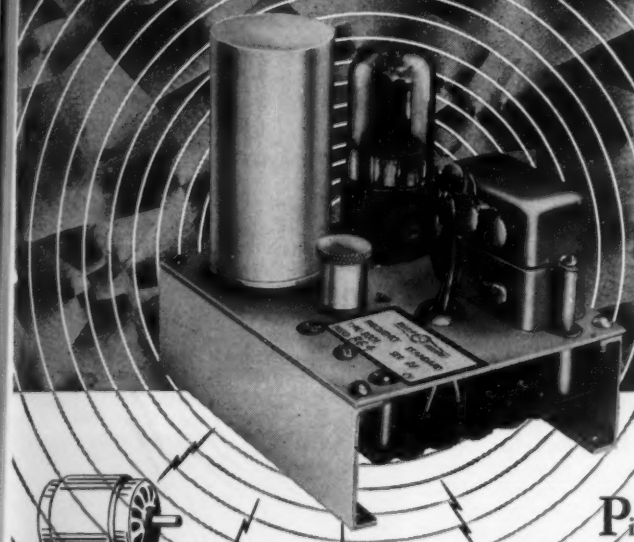
Please mention number **1004** when filling out card

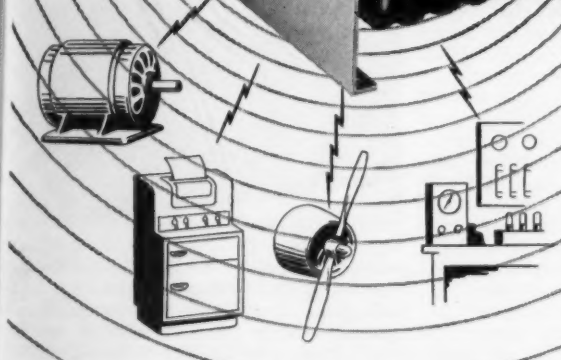
Contactless Electrical Micrometer

New "Dynamic Micrometer," when used with Du Mont "Model 208" oscillograph or equivalent, will measure movement, radial displacement or vibration of any part made of ferrous material. It does not touch moving part, therefore does not interfere with its movement. Displacement is readily read in 0.0001". Accuracy is claimed to be comparable to that obtained with a standard micrometer. Readings are made on a conventional micrometer sleeve about 2" in diameter, calibrated in thousandths and tenths without resorting to a vernier. Instrument's performance is independent of acceleration or frequency of displacement. All amplification is done at a constant "carrier" frequency which changes in

PICK A NUMBER

ANY FREQUENCY FROM 40 TO 1,000





Pictured here is a tuning-fork frequency standard with accuracy guaranteed to one part per million per degree Centigrade. The fork is temperature-compensated and hermetically sealed against variations of barometric pressure. This standard, when combined with basic equipment, facilitates accurate speed and time control by mechanical, electrical, acoustical or optical means.

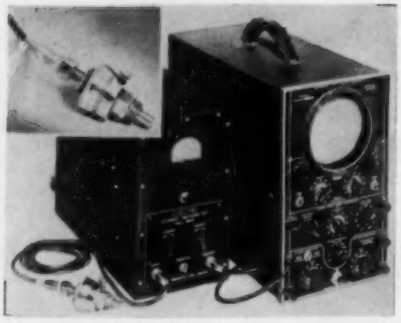
The unit is available separately or in conjunction with complete timing instruments. Our engineers are ready to cooperate on any problem.

MOTORS • FACSIMILE • AIRCRAFT • LABORATORIES

American Time Products, Inc.

580 Fifth Avenue

WESTERN ELECTRIC COMPANY



amplitude with changes in displacement or vibration. Amplifier and oscillograph are used only to establish an amplitude reference level. Frequency response of amplifier is not a factor in accuracy of measurement. Accuracy is the same for a static condition as for speeds up to 200,000 rpm. or vpm. Operating principle is similar to that of proximity fuse. Sensing element consists of a coil mounted so as to radiate high-frequency waves. Approach of magnetic material alters reactance of radiating coil. Changes of reactance are converted into electric voltages of varying amplitude. These voltages are amplified and modified to operate a pointer or produce a varying pattern on 'scope screen. To use "Dynamic Micrometer," sensing unit is mounted a few thousandths of an inch away from moving member and energy is fed into coil until a modulation pattern appears on 'scope. Minimum modulation point is observed, then sensing element is backed away by rotating micrometer head until maximum or modulation peak is reduced to previously-noted minimum: change in micrometer setting is equal to total displacement of moving part. Total weight 27 lbs.; dimensions 12⅛" × 7-1/16" × 18½".—*Electro Products Laboratories, Inc., 549 West Randolph St., Chicago 6, Ill.*

Please mention number 1005 when filling out card

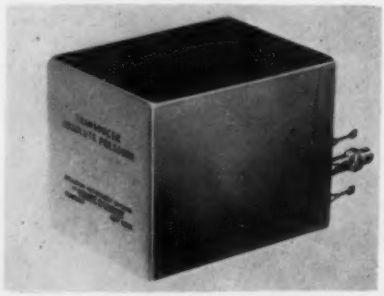
Combination Instrument for Air Velocity, Temperature, Pressure

New "Anemotherm" is announced as "a three-way air meter which gives air velocity, air temperature and static pressure readings at the turn of a knob." Its probe is small and is attached to a long flexible cable—thus, readings are easily made—even in the neck of an air diffuser. "Anemotherm" operates on self-contained batteries and is readily portable since it weighs only 11 pounds. It measures air velocity from 10 fpm. to 5000 fpm., said to be a wider range than ever before offered. It provides rapid-response measurement of temperatures from 30°F. to 155°F. Either negative or positive static pressure may be read directly in inches of water, from 0.05 to 10 positive and 0.05 to 4 negative.—*Anemostat Corp. of America, 10 E. 39th St., New York 16, N. Y.*

Please mention number 1006 when filling out card

Pressure Pick-ups for Radio-telemetering

New transducers convert absolute or differential pressures to electrical signals; are small and light-weight; are

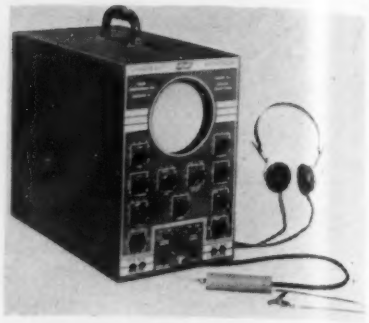


suitable for telemetering systems in connection with flight testing and control application in pilotless aircraft. They are said to achieve proper static balance imperative for minimizing acceleration error. No changes are noted when the transducer is subjected to vibrations having frequencies of 8 to 30 cps. with amplitude of 0.0625", or 100 to 130 cps. with amplitude of 0.005". Designed to minimize mechanical friction, transducer is also temperature-compensated, so that for temperatures from —20°C. to +50°C., error is less than 1.5%. Two types are available: varying resistor type which generally relies on d-c. source and which is 1½" × 1½" × 2" in size and weighs 6 oz.; induction type which has application in a-c. system and is 1⅞" × 1⅝" × 2-3/16" in size and weighs 8 oz. Both types are available in either absolute or differential pressure models and in various ranges. Resistor range of the varying-resistor transducer is 0-2500 ohms, but may be adapted to other specific requirements. Linearity is 1.5% and resolution 0.5% of total range. Electrical signal of the induction-type transducer can be employed in conventional synchro circuits, variable voltage output and phase-shifter circuits.—*Kollsman Instrument Div. of Square D Co., 80-08 45th Ave., Elmhurst, N. Y.*

Please mention number 1007 when filling out card

Radio and TV Tester and Oscilloscope

New "Cathode-ray Stethoscope" is said to be a completely new radio and TV servicing instrument. It combines two instruments: a 5" cathode-ray oscilloscope and the "Feiler Stethoscope." It is primarily designed for FM and television servicing and is also "ideal" for AM and audio work. It can be used in conjunction with a "Stethoscope" probe and earphones (supplied at a small extra cost), enabling the operator to see and hear the signal simultaneously. — *Feiler Engineering Co., 947 George St., Chicago, Ill.*



Please mention number 1008 when filling out card

Bridge Amplifier for Making Possible Pen-and-Ink Records

New "Ruge-de Forest Bridge Amplifier" is designed for use with resistance bridges ranging in impedance from 100 to 500 ohms and having a full-scale output as small as 25 microvolts per volt of input to the bridge, or as large as 5 mv. per volt. It is well-suited to work out of a wide variety of commercially available pick-ups for measurement of fluid pressure, load, torque, stress or strain, temperature, and other variables. Highly stabilized amplifier produces an output of 18 volts across an external 1500-ohm load with a linearity of better than 0.5%. Maximum sensitivity of such that a 120-ohm resistance wire strain gage bridge full output is obtained for a strain of 50 microinches per inch applied to only one

arm of bridge. Over-all stability for an eight-hour period is better than 1.5% of full-scale, regardless of range and including effects of line voltage variations from 100 to 130 volts. A 1200-cycle source of bridge power, complete bridge balance controls and balance indicator, precision attenuator, internal calibration, and precision phase-sensitive rectifier are features of new unit. Output is ample to drive pen-and-ink recorders as well as conventional indicating instruments. Frequency response is flat to ±2% from 0 to 50 cps. when working into a resistive load. When used with "Brush Magnetic Penmotor," over-all frequency response is flat to ±3% from 0 to 35 cps.—*Dep't Is, Ruge-de Forest, 76 Massachusetts Ave., Cambridge 39, Mass.*

Please mention number 1009 when filling out card

Grid-controlled Rectifier Tube

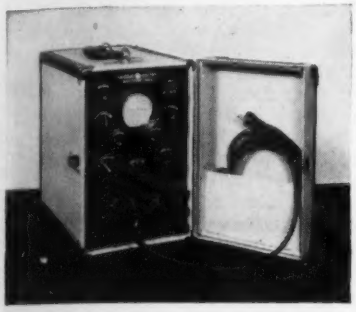
New "Type 5528 (C6L)" fast deionizing, temperature-free, grid controlled rectifier tube is designed espe-

cially for high power servomotor control or inverter applications which must operate at up to 800 cycles, and where utmost reliability and stable characteristics are required over wide ambient temperature ranges. Pertinent electrical characteristics are: 60 second heating time; 500 peak inverse volts; 4.4 amperes steady d-c. current; 77 peak amperes.—*Electrons, Inc., 127 Sussex Ave., Newark, N. J.*

Please mention number 1010 when filling out card

Multi-range High-current High-precision Current Transformer

New portable current transformer in the high-current range said to be more precise than any previously built, is based on a new principle in which error-causing effects of stray magnetic



fields from the same or other circuits are completely eliminated. It has an accuracy of ±0.1% and five minutes phase angle over the range of current from 10 to 150% at burdens up to 0.5 ohms (ASA standard B-0.5). It has eight current ratings from 1000 through 4000 amperes to 5 amperes. High accuracy is accomplished by passing primary current through the windings and then fanning out primary conductor into a copper shell and bending it back in a "U" turn completely surrounding the windings. Effect is to isolate the secondary completely from any field but that of the current being measured. Reluctance of magnetic circuit is reduced by using "Hipersil" and by a unique method of winding which sets up a circulating magnetic flux. This extra flux keeps magnetic particles in a state of agitation, reducing reluctance to approximately one-half normal values and cutting errors by the same amount. New transformer weighs approx. 130 lbs. and is provided with handles for carrying. Terminals are provided for connection of either cables or bus bars. —*Westinghouse Electric Corp., 306 4th Ave., Box 1017, Pittsburgh 30, Pa.*

Please mention number 1011 when filling out card

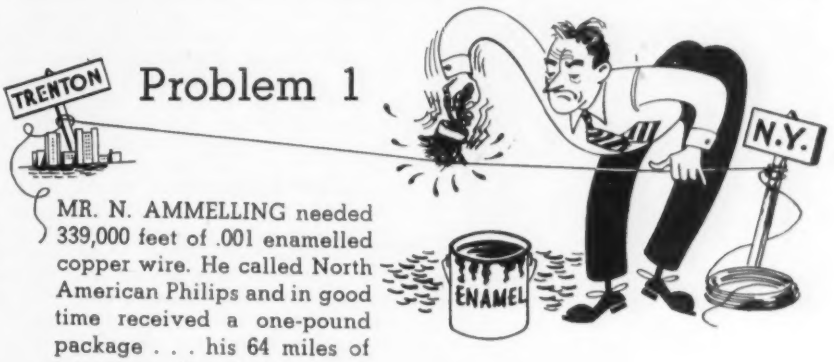
Alpha Proportional Counter System

New "Model 117 Alpha Proportional Counter System," designed for counting alpha particles in presence of a strong beta activity, consists of (1) methane flow proportional counter with sample holder; (2) built-in variable high-grain linear amplifier; (3) scale of 256 to 1; (4) built-in high-speed impulse recorder; (5) variable high-voltage supply. Methane counter chamber has highly polished cylindrical cathode.

What's your Problem?

Fine Wire? Tungsten? Molybdenum?

Problem 1



MR. N. AMMELLING needed 339,000 feet of .001 enamelled copper wire. He called North American Philips and in good time received a one-pound package . . . his 64 miles of wire enamelled to his specifications.

Problem 2

The firm of AL LOYS & AL UMINUM were in urgent need of fine aluminum and aluminum alloy wire for a delicate production job. Fine Wire Headquarters assured them that it was no problem at all. The order was placed, the Fine Wire delivered, and it performed to the complete satisfaction of all concerned.

Problem 3

MR. MUST B. PLATED, who required metal-clad wire for a specific application, phoned Fine Wire Headquarters. We supplied the base material to provide the physical characteristics desired, and plated it to meet his exacting specifications for special surface qualities.

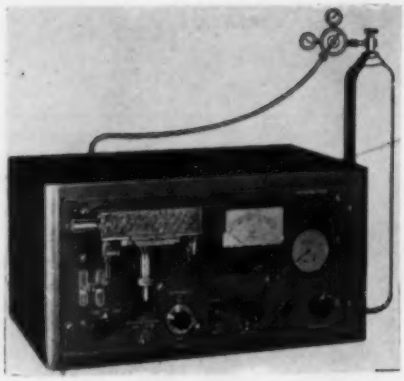
the answer

WHY not call Fine Wire Headquarters when you have a question about fine wire? We can't do the impossible, but we can do lots of things that can bring you the right fine wire for the job. So—when you have a problem on Fine Wire, Tungsten or Molybdenum—wire, phone or write to North American Philips, makers of NORELCO Fine Wires, and ELMET Tungsten and Molybdenum products.

NORTH AMERICAN PHILIPS COMPANY, INC.

Dept. XV-10, 100 East 42nd Street, New York 17, N. Y.

Export Representative . Philips Export Corporation
100 East 42nd Street, New York 17, N. Y.

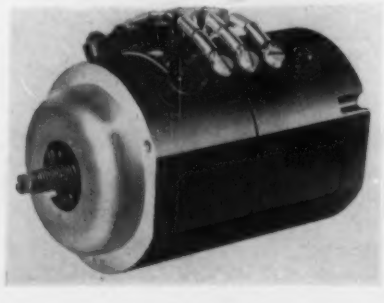


Anode is 0.002″ tungsten wire mounted between glass insulators. To clean chamber, bottom plate is removed, exposing cathode surface and center wire. Sample holder is for standard 1″ diameter samples with provision to raise sample up into the counting volume for improved geometry. A two-tube high-grain linear amplifier with a flat frequency response between 10,000 cycles and 2 Mc. has variable gain. Gain is controlled and set on panel dial set so that pulses from counter exceeding any desired amplitude between 2 and 20 mv. will trip scaler. This allows discrimination between pulses caused by beta particles and those of an alpha particle. Scaling circuit is of the binary type "Higinbotham" scaler. There are eight scaling stages giving a scaling ratio of 256 to 1. The first two stages have a resolving time of 2 μsec. while the remaining six stages will resolve pulses 5 μsec. apart. A scale-selecting switch permitting selection of scales 8, 64, 128, and 256 is controlled from front panel. Impulse recording unit is actuated by a driving tube driven by the last scaling stage. Utilizing scale of 256, impulse recorder is fast enough to accurately register an input counting rate of 500,000 counts per minute. High voltage for proportional counter is supplied by built-in stabilized variable voltage supply. The 4″ depressed-zero indicating instrument shows counter anode voltage reading from 1500 to 3000 volts. Complete unit is constructed on a single chassis and housed in a steel smooth enameled cabinet. — *Instrument Development Labs., Inc., 223 W. Erie St., Chicago 10, Ill.*

Please mention number 1012 when filling out card

Differential-type Engine Synchronizer

New "Synchronous Differential" for synchronizing engines serves as an intermediary regulating device of engine control equipment. It has other applications since it is, in effect, a torque-producing half-speed synchroscope. A single frame houses unit which weighs 28 oz. and which is 3-45/64″ long and 2⅜″ in diameter. Unit consists of two synchronous motors and a mechanical differential. Each synchronous motor reflects operating speed of an engine. These two motors in turn activate a ¼″ threaded output shaft which rotates at a rate equal to one-half difference of speeds of motors. However, when speeds of motors are equalized, output shaft of unit becomes stationary. Unusual efficiency and smooth operation are said to have been achieved through use of hysteresis motors which do not require external excitation and yield greater running torque than any other type of self-synchronous motor. They operate from a three-phase source over a frequency range of 15 to 60 cps. with an input voltage of 0.007 times the frequency in cycles per min. Also available are similar units wound for high voltages and two- or single-phase operation.—*Kollsman Instrument Div., Square D Co., 80-08 45th Ave., Elmhurst, N. Y.*



Please mention number 1013 when filling out card

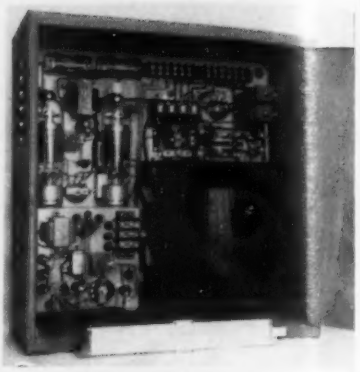
Instantaneous-reset Automatic Timer

New "Series PAC Timers" were specifically designed for process control in industrial applications where long life and trouble-free operation is a requirement. New simple clutching mechanism makes it possible to offer timers ranging from "PAC-5S" which has a timing range from 5 cycles to 5 seconds, calibrated in 5-cycle steps; to "PAC-3H" with a range from 2 minutes to 3 hours, calibrated in 2-minute steps. Special features include (1) Instant automatic reset: as soon as clutch is disengaged, an internal spiral spring brings actuating arm back to its reset position in a fraction of a second. (2) Time setting adjustment is accomplished by moving black button pointer to time cycle required. (3) Dial: easily-read, with large numerals.—*Industrial Timer Corp., 115 Edison Place, Newark, N. J.*

Please mention number 1014 when filling out card

Motor-speed Controller

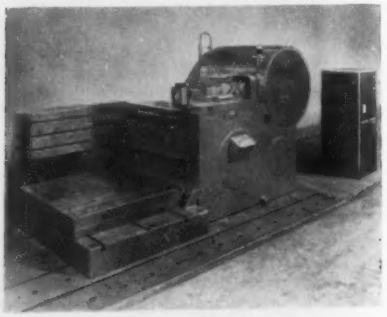
New "Bulletin 105" simplified electronic motor control permits operation of a d-c. motor from an a-c. power source without use of rotating conversion equipment. It is said to provide excellent low-regulation wide-range speed control. It contains only two electronic tubes (heavy-duty industrial type). No control tubes are used. It need not be protected with automatic current limiting circuits. However, automatic current limiting (automatic torque limiting) can be supplied as an optional feature if necessary to protect the load. Device is readily adaptable to various types of automatic control where it is necessary for speed of motor to vary in accordance with temperature, pressure, speed of another motor, load on another motor, etc.; is also available with special equipment for maintaining constant tension in reeling applications. It is available in single-phase models from 1/20 hp. to 3 hp. Polyphase models are available in higher hp. ratings. Both single-phase and polyphase models are available for standard and special input voltages and frequencies.—*J. B. Lewis & Co., 3324 Main St., Hartford 5, Conn.*

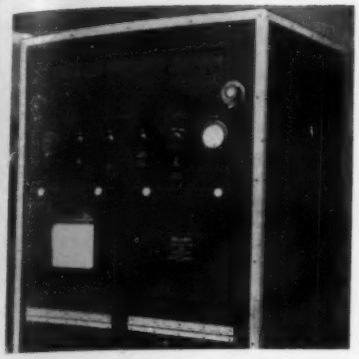


Please mention number 1015 when filling out card

Fatigue Testing Machine

New "Model BF-10-U" fatigue testing machine (Fig. 1) features a variable stroke up to 8″, loads up to 10,000 lbs. in tension and compression, and torsional fatigue loading. It is a flexible, crank-stroking type in which stroke is adjusted by a planetary gear system with an independent motor that maintains constant load by varying automatically the distance of a spindle from center of rotation. Large parts and assemblies up to approx. 5′ × 5′ × 5′ can be subjected to fatigue loading. Operated up to 250 cycles per minute. Automatic equipment for controlling and indicating load, and recording changes in stroke are contained in a separate cabinet (Fig. 2). Load sensitive element consists of a dynamometer ring so mounted as to transmit load to specimen. Dynamometer contains a variable-air-gap transformer, output of which controls a galvanometer in cabi-





net. Galvanometer reflects a luminous spot on a graduated scale to indicate load. Recorder chart shows change in stroke length with increase in number of cycles. Rate of feed of strip chart is set proportional to a known number of cycles, for example, 1" for 5000 cycles. Stroke length indicator, tachometer reading in strokes per minute, and counter are also included. The new machine is 12' 7" long, 74½" high, and 81" wide.—*Testing Equipment Div., Baldwin Locomotive Works, Philadelphia 42, Penna.*

Please mention number 1016 when filling out card

Photomicrographic Equipment

New camera and accessories make a complete photomicrographic laboratory in a single unit for visual observation and taking photographs at high or low magnifications, enlarged, actual size, and slight reductions, of transparent and opaque specimens. A sliding baseboard serves as a mount for changing from visual observation to photographic recording. All-steel construction is said to afford absolute rigidity and freedom from vibration. Camera has 5" × 7" reflex back. Unit accommodates a microscope that can be readily moved by means of the sliding baseboard to bring the eyepiece into position. New accessories are specimen illuminating units for high and low power photomicrography. Diversified light systems include both oblique surface illumination, direct transmitted, light, or a combination. Changes in light variations can be made quickly with a minimum number of accessories. For copying work, camera may be placed horizontally on the sliding baseboard. Lenses for copy work are provided for both black and white, and full color.—*Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.*

Please mention number 1017 when filling out card

Would

INSTANTANEOUS

recording of electrical phenomena from D. C. to 100 c. p. s. help in your research?

It's a fact — permanent, instantaneous ink-on-paper recordings by Brush Oscillographs make their use almost unlimited!

Accurate recordings of voltages, pressures, radiation intensity and countless other phenomena can be made over a frequency range of D.C. to 100 c.p.s. Either A.C. or D.C. signals can be measured. Whenever desired, recordings may be stopped for notations on chart-paper.

Investigate *Brush* measuring devices before you buy . . . they offer more for your money. Why not have a Brush representative call? At no obligation, of course.

Just call or write — today — you'll find it worth a few seconds' time!

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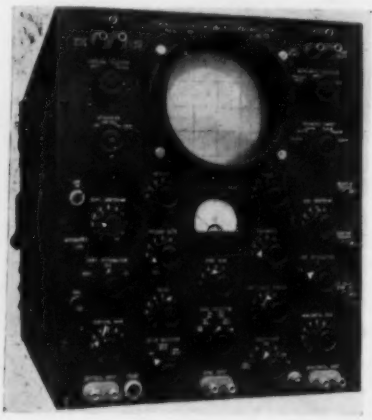
INDUSTRIAL INSTRUMENTS DIV. • CRYSTAL DIVISION

Canadian Representative: A. C. Wickman, (Canada) Ltd., P. O. Box 9, Station N, Toronto 14

Oscillosynchroscope

New "Model OL-15B" oscillosynchroscope is for observation of transient and recurrent phenomena involving wide ranges of frequencies. A 5" cathode-ray tube with 4000 volts accelerating potential provides superior



intensity and definition of images. Other features include a vertical amplifier bandwidth of 6 Mc., recurrent sweeps of 5 to 500,000 per second and driven sweep rates of 0.25 to 200 microseconds per inch. An internal trigger generator is also provided as well as a variable delay circuit which may be used to provide delayed triggers or a delayed sweep either internally or externally triggered. A calibration device provides measurement of deflection sensitivity through the amplifier. Vertical amplifier which is linear without positive slope from 10 cycles to 6 Mc. has a transient response such that a 100 kc. square wave which rises or falls at the rate of 500 volts per microsecond is faithfully reproduced. Self-contained in steel cabinet, 13¼" × 15¾" × 19¾". Weight, 95 lbs.—*Browning Laboratories, Inc., 750 Main St., Winchester, Mass.*

Please mention number 1018 when filling out card

Instrument-air Dryers

New "BY" line of "Lectrodryers," primarily designed for drying instrument air, are built in accordance with A. S. M. E. Code requirements, are fully automatic which makes possible reactivation, cooling and reversal of machines' dual adsorber towers without manual attention. They require considerably less space than manually-operated dual adsorber "Lectrodryers" of comparable capacity; are built for operation on pressures up to 150 lbs./in.^{2} g. with option of either steam or electric reactivation. Machines for higher pressures will also be made available on specification. There is a wide range of standard sizes up to 5,000 scfm. and larger sizes will be available as special machines. The only moving parts are the reactivating pump and valve reversing mechanism. The "BY" line removes moisture from air and gases by means of "solid adsorption" with activated alumina.—*Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh 30, Pa.*

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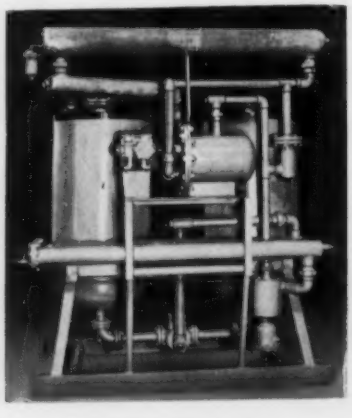
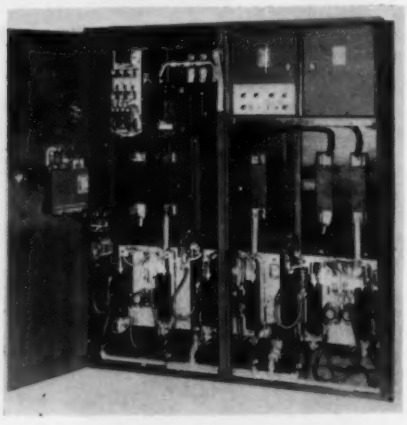


Welding-control Combination

New "Model 312KS2" 3-phase multiple-control combination has a remote control relay-timer which provides a

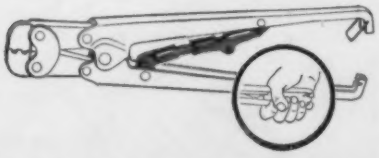


variety of multiple welding sequences: Weld #1, #2, #3, cascade, or simultaneous, with independent dial adjustment of weld time on each phase. Automatic control circuit protection is incorporated. Built-in disconnect switch or circuit breaker is available so power may be wired directly to unit. Circuit-breaker with interrupting capacity to 50,000 amps. may be supplied. Standard equipment includes built-in "Water Saver," with solenoid-operated water valve and water lines housed within the cabinet. A magnetic contactor for remote control, or motor starter is offered, and 1 to 3 kva. step-down transformer is available to supply auxiliary equipment. Complete control over 3, 6 or 9 transformer groups may be accomplished using auxiliary timers.—*Weltronic Co., 19464 W. Eight Mile Rd., Detroit 19, Mich.*

Please mention number 1020 when filling out card

Solderless-wiring Hand-tools

New "Certi-Crimp" hand tools eliminate possibility of faulty electrical connections resulting from operator fa-

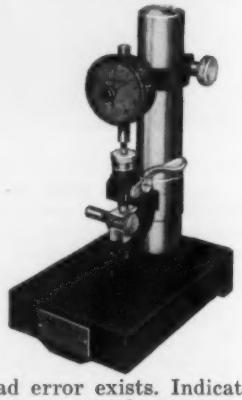


tigue or carelessness. They incorporate a device that prevents re-opening tool for admission of a new terminal until it has been completely closed for a perfect crimp on a previous terminal.—*Aircraft-Marine Products, Inc., 1569 N. 4th St., Harrisburg, Pa.*

Please mention number 1021 when filling out card

Thread Comparator

New "Swanson" thread comparator tells at a glance whether product is oversize, undersize, eccentric, tapered

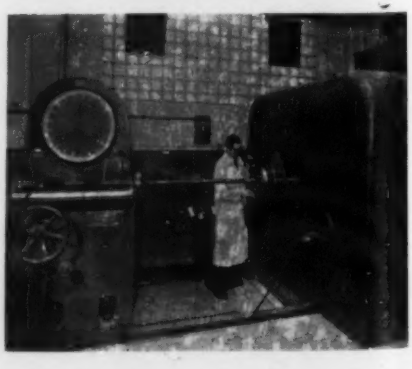


or if lead error exists. Indicates work visually to accepted ring gage tolerances, eliminating human error. The "Swanson" comparator consists of a stand with indicator and standard thread unit. To use—insert setting plug, lower the upper anvil with lever, swing unit under indicator, setting it at tolerance required. A positive swing stop locates anvil unit in correct reading position. Instrument is said to be ten times faster at checking gages than the ring gage method. Gage anvils are ground and lapped to class 4 specifications of Screw Commission standards. Component parts are cast iron, reinforced at points of contact with precision ground steel parts, hardened and lapped to withstand wear.—*National Automatic Products Co., 23 Whiting St., New Britain, Conn.*

Please mention number 1022 when filling out card

Torsion Testing Machine

New "Mack Torsion Machine" has a maximum capacity of 1,000,000 inch-pounds, is large enough to test bars or tubes up to 10′ long and 6″ in diameter. In consists of a rigid base frame, a drive head at one end and a weighing head that travels on two racks and tracks on base frame and can be clamped to base at any desired position. Weighing head measures torsional loads in either direction of rotation. It is equipped with two face plates to which test specimens can be fastened. One (on side toward driving head) is used for torsion tests; the other is used with an adjoining torsional fatigue machine to determine relation between ap-



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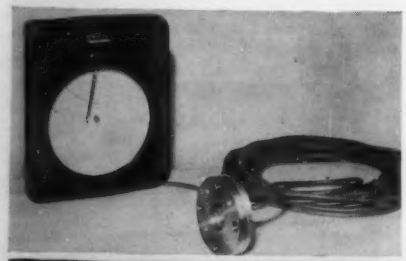

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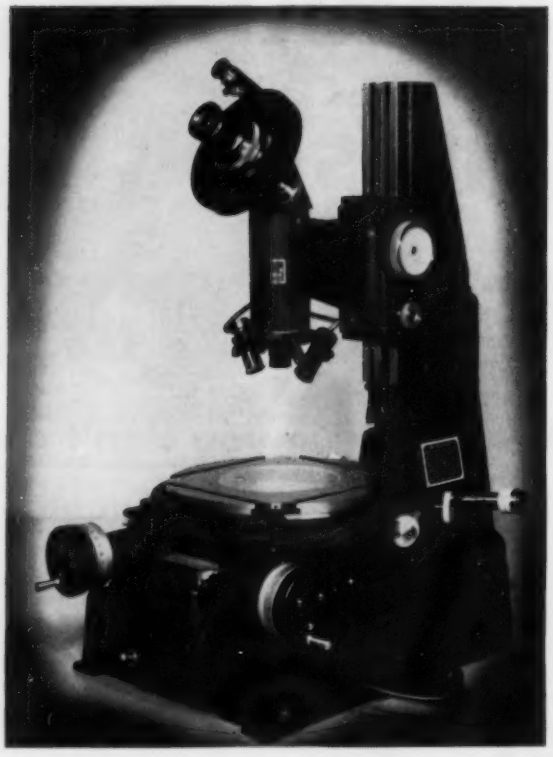

Especially useful for checking gear tooth spacings, laying out cam contours, and in performing numerous other precision measurements in either rectangular or polar coordinates.

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plied torsional load and angle of deflection before starting torsional fatigue tests. A fixed frame member of fatigue machine is then substituted for Baldwin weighing-head face-plate. Drive head is powered by a controlled variable-speed d-c. motor with a 20-to-1 speed range. However, by means of two gear ratios, spindle speed can be varied between 1 and 20 degrees per minute and between 20 and 400 degrees per minute, thus giving a loading speed range of 1 to 400. Angular measurements can be read to 0.1° by a vernier on chuck at power end. Torsional loads are applied in weighing head to an Emery capsule. A standard Tate-Emery indicator takes hydraulic pressure in a Bourdon tube that is restrained from deflecting by a pneumatic system sensitive to air pressure changes that occur when Bourdon tube disturbs a baffle plate over an air jet. A pressure-sensitive bellows in pneumatic system restrains deflection of baffle and Bourdon tube through an "Iso-elastic Spring." Four load ranges are available for torsional tests: 10,000; 50,000; 200,000; and 1,000,000 inch pounds. On each range, accuracy 0.5%.—*The Baldwin Locomotive Works, Philadelphia 42, Pa.*

Please mention number 1023 when filling out card

Student's Microscope

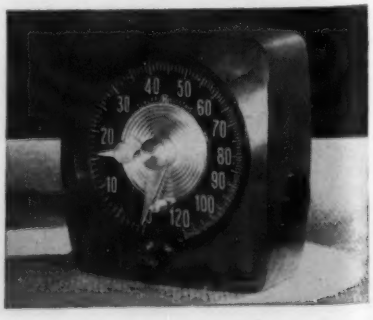
New standard size low-cost microscope is equipped with 10-power Huygenian eyepiece with specially designed

parfocal achromatic objectives. It provides 100 and 500 dia. magnifications.—*Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.*

Please mention number 1024 when filling out card

Interval Timer

New "Type T-48" automatic interval timer, powered by a synchronous, self-starting, permanently lubricated "Tele-

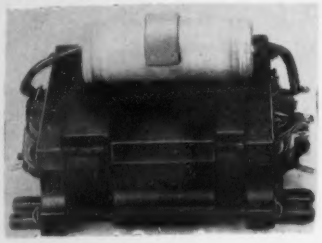


chron" motor, operates on 120-volt, 60-cycle a.c., with maximum load of 1,200 watts. Triple-action control knob permits manual or automatic operation. At end of any cycle timer resets automatically. "Type T-48" timers to measure the following time intervals are available: 0 to 120 secs.; 0 to 15 mins.; 0 to 2 hrs.; 0 to 12 hrs.—*Meter and Instrument Div., General Electric Co., Schenectady, N. Y.*

Please mention number 1025 when filling out card

Miniature-voltage Stabilizer

New "VR-6000" voltage stabilizer has been custom engineered specifically for building into electrical equipment

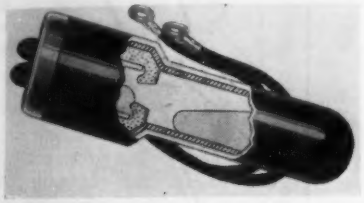


where space and weight limitations are critical. Operates at input voltage of 95 to 130 volts a.c., 60 cycles, single-phase, with output of 120 volts stabilized to ±0.5%.—*Raytheon Manufacturing Co., Waltham, Mass.*

Please mention number 1026 when filling out card

Metal-cased Mercury Switches

New "Durakool" mercury switches have an electric weld which seals hydrogen gas under pressure in metal



case. Closure keeps pressure intact whether switch is in use or inactive. Hydrogen kills usual arc between mercury and contact points so that corrosion is all but eliminated. Metal case acts as one electrode. In "Double Flow" model, make and break contacts are between two mercury pools, thus further reducing any possibility of corrosion. Manufacturer states that new models are especially efficient in high-capacity highly-inductive circuits, or where variable loads place undue strain on ordinary switches.—*Durakool, Inc., Elkhart, Ind.*

Please mention number 1027 when filling out card

Variable D-c., A-c. Chopper

New "Type 222" chopper, for use with thermocouples, strain gages and other low-level equipment, converts

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Technical Methods

To Help You Increase Efficiency

Light Projector Increases Thread Grinding Production

Production of thread grinding machines can now be increased through the use of a light projecting device called the Thread Pick-up Projector. The thread profile appears in a viewing screen, magnified 20 times, thereby permitting accurate visual adjustments.

In operation the Thread Pick-up Projector is placed alongside the thread grinding machine. A Dalzen Thread Grinder, Model No. 1, is shown above. While the machine is grinding the thread, the operator, using the Light Pick-up Projector, adjusts a "dog" on the next piece to be ground. When the "dog" and piece are then placed in the thread grinder the thread profile is automatically in location and ready for grinding immediately.

Even the most inexperienced personnel can "pick up the thread" using this instrument after only a few minutes demonstration. Grinding is also done more accurately and the viewer permits measurements of reliefs, notches, etc. to .0005 inch.

Efficiency of production can also be increased through the use of chewing gum. The act of chewing helps relieve nervous tension and seems to make the work go easier and faster. For these reasons, Wrigley's Spearmint Chewing Gum is being made available more and more by plant owners everywhere.

Complete details may be obtained from
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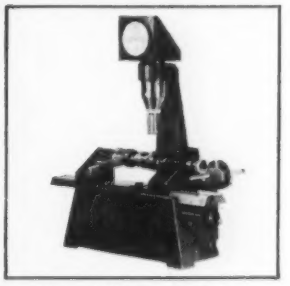

Thread Pick-up Projector

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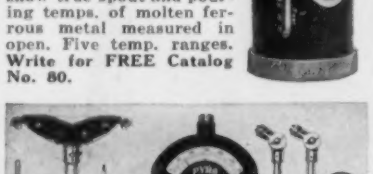

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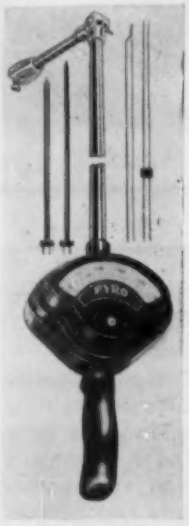

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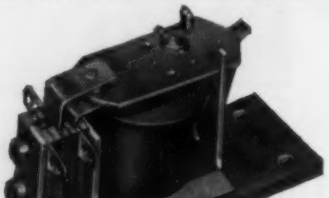
pure d.c. either to pulsating d.c. or a.c. so that output can be amplified with a-c. equipment. Provides all frequencies from 10 to 500 cycles, including the 400-cycles employed in aviation. Instrument incorporates two independent floating armatures to serve as a s-p.d-t. electromechanical chopper, as a rectifier or as a square-wave generator (range 10-500 cps.). Nominal contact rating is 0.05 amps., 50 volts d.c. with maximum of 0.5 amp., 110 volts d.c. Load may be resistive or inductive. Under inductive load, voltage and current should not exceed 0.05 amps., 50 volts. Fully-shielded coil is rated at 12 volts, 10-500 cycles and phase shift is about 4% at 60 cycles, 12 volts, or about 10% at 500 cycles, 12 volts.—*Stevens-Arnold, Inc., 22 Elkins St., South Boston 27, Mass.*

Please mention number **1028** when filling out card

D-c. Relay

New "Type E" sensitive d-c. relay is primarily for electronic tube circuits, alarm systems and similar applications.

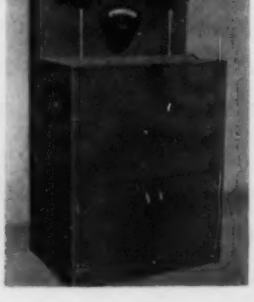


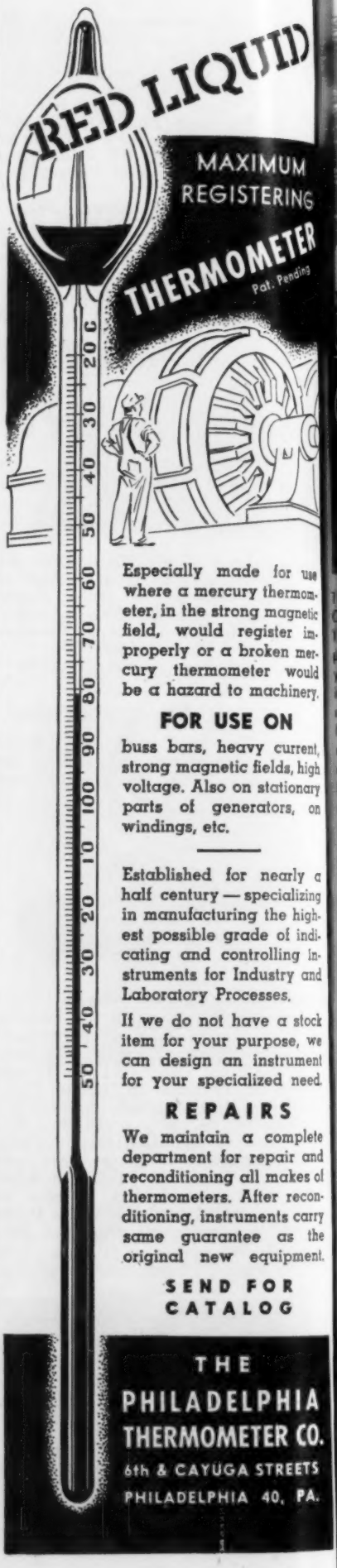
According to manufacturer, this new unit, with an over-all size of 2½" × 1¼" × 1½" is ideal for use in compact assemblies and where control requirements do not exceed s-p.d-t. Has a contact capacity up to 5 amperes, at 25 volts non-inductive load. Power consumption 60 milliwatts. Supplied with fine silver contacts, or other material on specification.—*Comar Electric Co., 3148 N. Washtenaw Ave., Chicago 18, Ill.*

Please mention number **1029** when filling out card

Temperature-instrument Calibrating Apparatus

New "Model C-119" dual liquid immersion testing unit, designed for use in testing and calibrating thermometers, thermocouples, pyrometers, etc., is of twin tank design; has an operating range of 70 to 700°F. (depending upon liquid used). Each tank is equipped with individual temperature control, liquid agitator, conveniently-located drain cock, and vented tank cover for attachment to fume elimina-





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IRON-CONSTANTAN, Cat. No. 1236-C, 14 ga., STRANDED-DUPLEX, each wire felted asbestos, Asbestos-yarn braid overall.

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tion systems. Each tank holds approx. 4 gals. of fluid and will accommodate primary elements up to 17" in length. Operating cost is minimized because cabinet housing is insulated with 3" thick magnesia block. Electric motors powering agitators operate on 110-volt a.c. and heating elements on 220-volt a.c. Bristol temperature control instruments limit liquid temperatures to within ±1% of temperature setting throughout operating range. Floor model illustrated stands 54½" high, is 28" wide, 20" deep, has large storage cabinet underneath tanks. Single-tank bench models and four-tank floor units are available also. Tank capacities can be varied and temperature range adjusted for specific applications.—*Dept. No. 24, K & H Industrial Products, Inc. 459 Morgan Ave., Akron 11, Ohio.*

Please mention number 1030 when filling out card

High-voltage Multiplier Leads

New "H.V.M." high voltage multiplier leads convert any low voltage multimeter or any vacuum tube voltmeter into a high voltage instrument. "H.V.M." leads have high-voltage type resistors built into prod handles so that practically entire voltage drop takes place before wire lead of cord is reached and instrument end or tip is relatively "cold." Only lowest range, such as 2.5-3-5-10-12-15, is used, depending upon scale range of instrument. Multiplier accuracy is maintained within 2%. Alligator clip terminal is supplied for solid grip at the point of measurement. "H.V.M." leads are available in voltage ranges of 5,000 to 30,000. Each range may be had in sensitivities of 20,000, 10,000 and 5,000 ohms per volt. Special voltage ranges and sensitivities for vacuum-tube voltmeters can be supplied upon request.—*Reiner Electronics Co., 152 25th St., New York 1, N. Y.*

Please mention number 1031 when filling out card

Flight- and Ride-test Magnetic-recorder Mechanisms

New "Types MR-2, MR-3 and MR-6" Data Recorders (upper left, lower left, and lower right, respectively in illustration) are designed for building into vehicles, aircraft, guided missiles or other mobile equipment. They use magnetic tape to store variable or transient data under conditions of severe shock acceleration for later re-running and analysis. All designs have multi-information channels and a time-base channel for speed and error compensation purposes. "Type MR-2" is a 12-channel magnetic tape recorder mechanism; has recording time of 15 minutes; is applicable to flight tests of

Century

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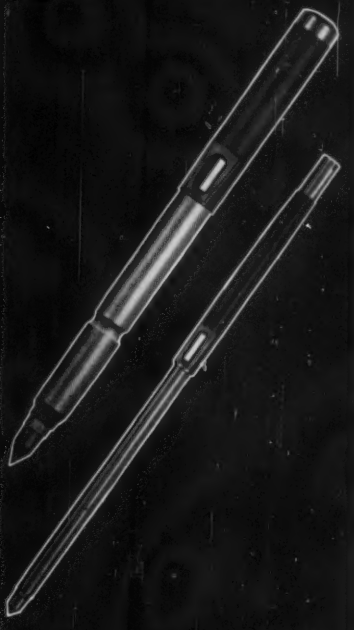
Available with natural frequencies from 15 c.p.s. to 1500 c.p.s., electromagnetically damped and to sensitivities as high as 2" per microampere at 1 meter focal distance.



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The Model G-14 in hard chrome plated brass tube and the Model 205 of heat-treated, non-magnetic stainless steel. Rugged and durable, yet possesses extreme sensitivity. Internal suspensions are manufactured by a patented process which provides unequaled balance. Hermetically sealed giving maximum efficiency under all climatic conditions.

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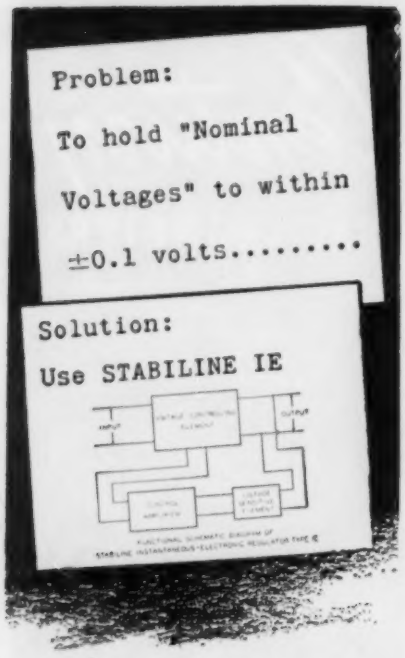
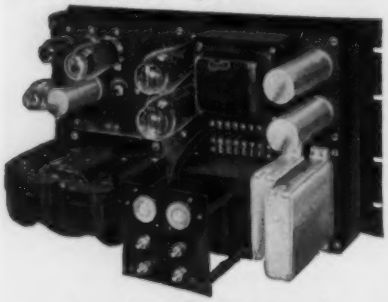


Your utility company may quote a nominal voltage — but power suppliers are allowed to vary, within certain limits, from the nominal. This condition, plus load changes in your own operation, results in voltages other than nominal. A STABILINE Automatic Voltage Regulator Type IE in your power line assures you of constant voltage. It's *instantaneous* in action — completely *electronic* in operation. Holds delivered voltages to within ±0.1 volts, regardless of line variation . . . within ±0.15 volts for any load current change or load power factor change from lagging .5 to leading .9. Maximum waveform distortion never exceeds 3 percent.



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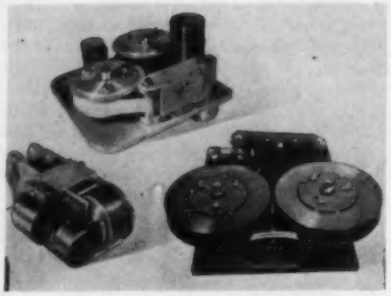

engine temperatures, accelerations, strains, etc. "Type MR-3" is a 6-channel miniature recorder mechanism; recording time 3 minutes; small size (6½" × 3⅛" × 2¼"); light weight (24 oz.); especially suitable for guided missile application. "Type MR-6" is a standard 6-channel magnetic tape recorder for numerous applications where units of normal weight and size are permitted; recording time, 25 minutes. —*Cook Research Laboratories, 1457 Diversey Parkway, Chicago 14, Ill.*

Please mention number 1032 when filling out card

Humidity Control System

New humidity control system for protecting barns, livestock and farm equipment controls fans and other devices, automatically maintaining temperature and humidity at desired levels. Maker claims it will also eliminate spontaneous combustion dangers, fodder mildewing and spoilage.—*Brown Div. Minneapolis-Honeywell Regulator Co., Wayne and Roberts Aves., Philadelphia 44, Pa.*

Please mention number 1033 when filling out card

Automatic Timers

New "Type TP and TS" industrial timers, for manufacturing and service establishments where permanent con-

duit or BX installations in standard switch box cases are desired, are enclosed in a rugged steel case finished in permanent black wrinkle. Dual-disk face allows ease of accurately setting up the desired program. These timers are not subject to federal excise tax charges. Model TP is for bell ringing or signalling purposes and makes a single circuit contact at any 5-minute interval during a 24-hour period and repeat each day. Ringing period is adjustable from one to 30 seconds. Model TS is an industrial control timer which incorporates a holding circuit. It closes circuit on first impulse and opens it on succeeding impulse. It will automati-

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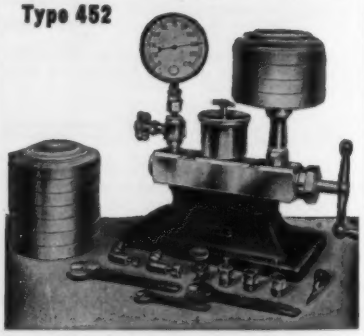
AMTHOR Dead Weight Pressure Gauge TESTER
Type 452



Modern design and construction puts this rugged precision instrument in a grade above the ordinary dead-weight testers.

Made in ten ranges, to 5000 lbs. maximum.

We guarantee 1/10 of 1 percent accuracy in each range.

The Type 452 is designed for simplicity and compactness. It incorporates the newest refinements and improvements. Adapters and tools are supplied, as well as either carrying case or protecting cover.

Immediate and intelligent attention will be given to your inquiries on all industrial speed measurement problems.

Drop us a line today.

Amthor Testing Instrument Co., Inc.
49a Van Sinderen Ave. Brooklyn, N. Y.

Remember
when . . . . . .

instrument maintenance cost 65c per hour? Today it's a factor that will make you appreciate the design and materials used in the Full-View Rotameter with Safety Shielding This rotameter goes together with dowel pins for quick assembly, perfect alignment and complete rigidity. It has stainless steel gland bolts that always turn freely. For a small extra charge, it can be coated with "Brookote", the new finish that is impervious to practically all chemicals. To investigate these savings in rotameter maintenance, write for Catalog #20.

BROOKS ROTAMETER CO.
Box A-51048 Lansdale, Pa.

RAWSON ELECTROSTATIC VOLTMETERS
Type 518

Now available to 35,000 VOLTS
Measure true R.M.S. values on A.C., no waveform or frequency errors.

NO POWER CONSUMPTION
Leakage resistance greater than one million megohms. These meters may be used to measure

STATIC ELECTRICITY !
Ideal for measuring high voltage power supplies with zero current drain. Rugged, well-damped movement. All elements surrounded by metal shielding for accuracy and safety.

Write for new bulletin.

RAWSON ELECTRICAL INSTRUMENT COMPANY
112 Potter St. Cambridge, Mass.

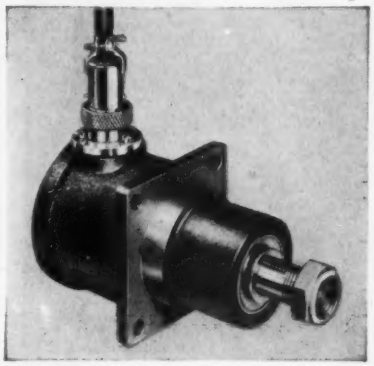
Representatives
Chicago - New York City - Los Angeles

cally turn on and off ovens, soldering irons, lights, fans, etc., at any present time and automatically repeat this process at prescribed intervals during the 24-hr. period.—*Montgomery Mfg. Co., 549 W. Washington Blvd., Chicago 6, Ill.*

Please mention number 1034 when filling out card

Tachometer Magneto

New "Model M-1200" electric tachometer magneto, designed for continuous operation, measures 2¾" × 5⅜"; is housed in a cast bronze case; will operate in any position through a wide

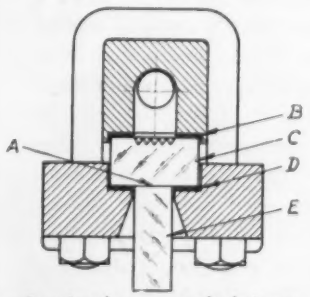


range of temperatures. Announcement states that owing to many design innovations, new magneto provides exceptional performance over a wide range of speeds and is substantially free from effects of stray magnetic fields. Grease-packed ball bearings assure long life. Various shaft arrangements are available to meet wide variety of operating conditions, "including many of the most difficult from an engineering point of view." A suitable assortment of indicating instruments is available.—*The Electric Tachometer Corp., 2218 Vine St., Philadelphia 3, Pa.*

Please mention number 1035 when filling out card

Non-frosting Liquid-level Gages

(1) New "Flat Glass Non-frosting Gage," said to be ideal for plants where low-temperature fluids must be gaged, may be made in any material to meet

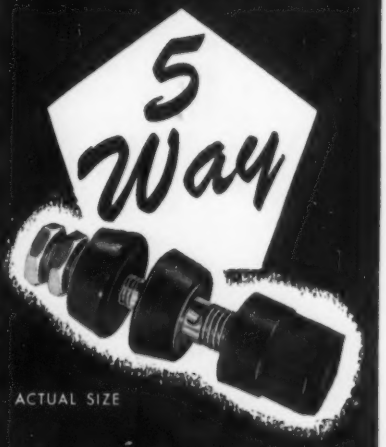


A – Coating keeps out air between glass and plastic.
B & D – 1/16" thick fibre gaskets.
C – Pyrex glass.
E – Transparent plastic extension.

any operating conditions. Feature is a transparent plastic unit sealed to gage glass, which projects beyond cover bolts so frost cannot build up across vision slot in cover forging. New gage is available in both reflex and transparent types.

(2) New "Tubular Non-frosting

THE SUPERIOR 5 Way



ACTUAL SIZE

BINDING POST
AVAILABLE NOW WITH CAPTIVE HEAD

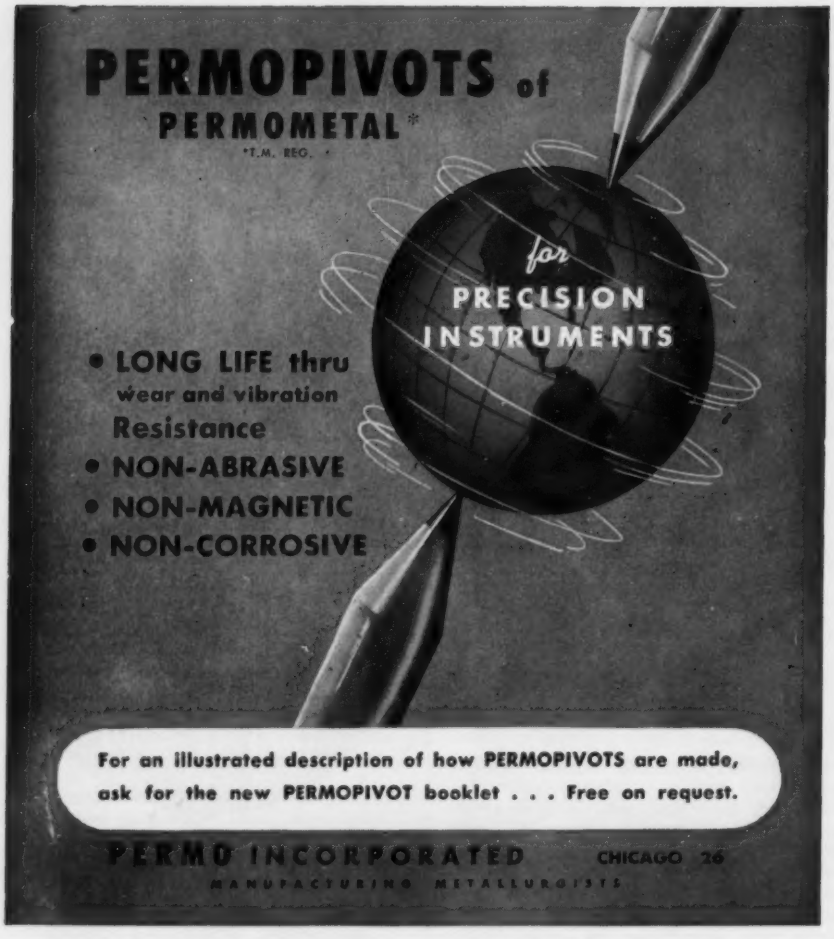
The Superior Electric Company has developed this binding post to give complete insulation, 30 ampere current capacity and 1000 volt working voltage. The captive ½" hexagonal head eliminates fumbling—makes a fast, complete, multi-purpose electrical connector.

Features Five Connections

1. Permanent clamping of wire up to #12 through center hole.
2. Looping of wire around center shaft and clamping.
3. Plug-in of standard ¼" banana plug.
4. Clip-lead connection by turning hex-shaped head to end of shaft.
5. Spade lug connection.

The 5-WAY Binding Post, available in tough red or black phenolic plastic, is offered for immediate delivery. Write for descriptive literature today.

THE SUPERIOR ELECTRIC COMPANY
710 Meadow Street
BRISTOL, CONN.



QUIK-LABELS
CODE CARD SYSTEM
Removable Self-Starter Strip exposes ends of Labels for you to peel
DON'T PICK. USE SELF-STARTER STRIP TO PEEL LABELS.
FREE SAMPLES
DON'T PICK. USE SELF-STARTER STRIP TO PEEL LABELS.
1 PEEL
2 APPLY
3 IDENTIFY
LIKEWISE ON FLAT SURFACES
*Patents Pending

QUIK-LABELS
Mark Your Wires Faster

QUIK-LABELS code wires, leads, circuits, relays, parts, etc. faster and at lowest buy-and-apply cost. Pre-cut to exact size, QUIK-LABELS come on handy cards, stick without moistening. Replace slow and costly string tags, roll tapes, decals, metal tags, etc. Silicone plastic coated to resist dirt, grease, moisture and abrasion. Exclusive Starter-Strip automatically releases any or all labels; it is faster, safer, snag-proof. Over 700 NEMA and ASA markings and colors in stock. Maintenance men carry cards to the job. QUIK-LABEL Dispenser holds cards for production operators and leaves both hands free for faster work. QUIK-LABELS are sold by distributors in over 125 principal cities of USA and Canada. Write for useful literature and FREE sample cards.

W. H. BRADY COMPANY
Established 1914
Manufacturers of Self-Sticking Tape Products
804 N. 3rd Street, Milwaukee 3, Wisconsin
Factory—Chippewa Falls, Wisconsin

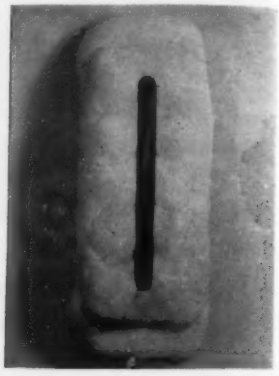
PRECISION SURFACE CLEANING

Straight line production requires speed and flexibility in the cleaning of fine parts. The ENG-SOL Method of precision cleaning uses a high velocity spray of solvent and air—a single shot thoroughly cleans the surface—frees it of lint, fingerprints, lapping compounds or other contamination. Extremely safe—can not burn nor explode at any temperature.

Write for the illustrated booklet describing The ENG-SOL Method of precision cleaning. Consult our Research Dept. for information pertaining to your particular precision parts cleaning problem.

PASSAIC ANALYTICAL LABORATORIES, Inc.
228 Aycrigg Ave. Passaic, N. J.

Gages" have double-wall tubular glass with a vacuum between the two walls.



It is said that "since no air comes in contact with the glass there is no condensation and it is therefore impossible for the glass to frost up."—*Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.*

Please mention number 1036 when filling out card

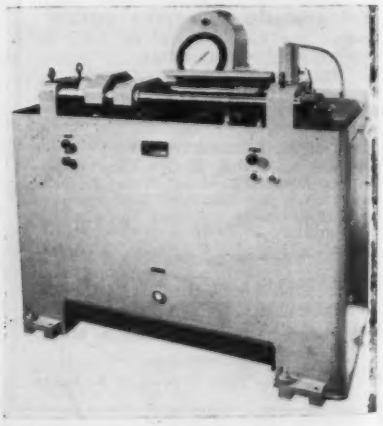
High-speed D-c. Relay

New "Millisec Relay Type 162" has double windings operating coil and holding-in coil. Operating time is one millisecond or less; operation is mechanical, not electronic. It is made in one size only, s-p.d-t. for use with resistive or capacitive loads. (When used with an inductive load, special tests are required at factory.) Addition of holding-in coil makes it suitable for photoflash units and other applications where ultra-high-speed closing time is required, followed by a long holding-in period. Contact rating is 110 volts d-c. 0.5 ampere. Life expectancy varies from 22,000,000 operations at 0.5 ampere to 100,000,000 operations at 0.25 ampere. Coils are made to special order.—*Stevens-Arnold Co., 22 Elkins St., South Boston, Mass.*

Please mention number 1037 when filling out card

High-pressure Tubing-testing Machine

New hydrostatic testing machine, for pressures up to 20,000 lbs./in.^{2} is for testing tubing of various lengths. Machine seals end of tubing without any perceptible flare; eliminates air; and builds up to required pressure. For a predetermined time cycle it holds pressure and then automatically reverses and is ready for next test.

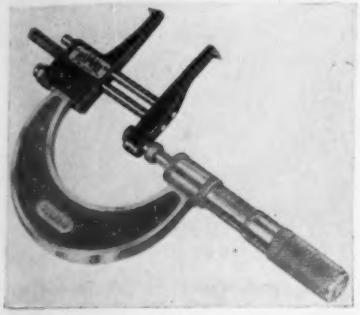


Pressure gage can be disconnected during test; peak test pressure is indicated by red light on panel. Time cycle is approx. four seconds. Equipment consists of hydraulic pump and motor, electrical timers and switches, solenoids, relays and valves. Electrical panel is made integral with base. Occupies floor area of 15 square feet and has an overall height of 5'. Also built for higher pressures.—*Steel City Testing Machines, Inc., 8843 Livernois Ave., Detroit 4, Mich.*

Please mention number 1038 when filling out card

Inside-dimension Attachment for Micrometers

New "Rimat Microdapter" is an attachment for outside micrometers which permits measuring internal di-

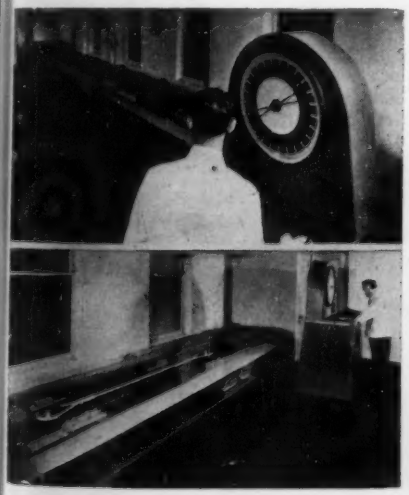


mensions. All-steel "Microdapter" can be installed or removed in less than one minute.—*Richards Machine Tool Co., 124 S. Isabel St., Glendale 5, Calif.*

Please mention number 1039 when filling out card

Rope- and Cable-testing Machine

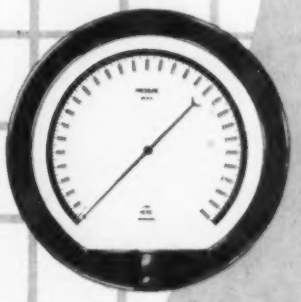
New horizontal tensile testing machine handles long specimens of rope, wire, cable, chain, belting and like flexible tensional materials. Designed to test specimens with high elongations at loads up to 120,000 lbs., it takes specimens from ¼" to 4" in diameter with a maximum stretched length of 25 feet under full test load. Minimum length of specimens is two feet. An important feature is unlimited stroke within maximum distance of 25' between grips, which permits high elongations. Driving speeds of ⅜" to 18" per minute can be maintained accurately in either direction of movement. A strain rate pacing disk on the dial of the in-



one-second zero setting with revolving dial and external knob

HEISE GAUGES

STANDARD OF THE WORLD



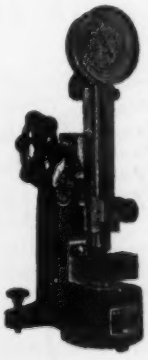
Zero adjustment in Heise Bourdon pressure gauges is simply a matter of turning an external knob with the fingers. No tools are needed. Nothing is removed. The knob rotates the dial until zero and pointer coincide. Direct readings of absolute pressure can be made by setting the dial to agree with barometric pressure.

Three sizes: 8½ in., 12 in., and 16 in., in ranges from 0-15 to 0-10,000 psi. Prices from $151.60 to $211.20. Write for catalog.

Heise Bourdon Tube Company, Inc.
Newtown, Connecticut

HARDNESS TESTING...

done WITH NO MENTAL HAZARDS. The SCLEROSCOPE has done it for the past 40 years.



In general use for specification purposes. Simple, sturdy. Comparatively inexpensive.

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The Shore Instrument & Mfg. Co., Inc.

9025 Van Wyck Ave., Jamaica 2, N. Y.

HERE'S REAL NEWS

A NEW *High Power, Lighter Weight* PORTABLE POWER UNIT

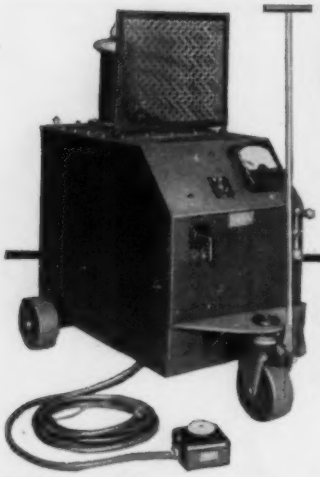
New Burgess A.M. Power Unit

For high power from a small unit, the new Burgess A. M. Power Units are *unexcelled!* Single cell units scarcely larger than an ordinary flashlight cell deliver currents as high as 100 amperes, at approximately 1.4 volts!

A. M. Units are packed dry and activated with water . . . once activated they may be efficiently discharged at temperatures as low as −60°F. and as high as +150°F.! Write Dept. AM for full information on standard and special types.

BURGESS

BATTERY COMPANY FREEPORT, ILLINOIS



Portable Tester

50,000 VOLTS
5 KVA

This is one of our most popular a-c testing equipments—suitable for testing motors up to approximately 200 hp and transformers up to about 2500 kva.

Operates on 60-cycle, 115/230-volt supply. Provides smooth, stepless test voltages over the entire range from practically zero to 50 kv. Has accurate, double-scale voltmeter and is equipped with an air circuit breaker with overload trip. Safety features—including foot switch, grounding lead, screen, and signal lamp—protect operators.

All wheels are equipped with roller bearings. Projected floor space is 41″ x 26″—over-all height is 44″.

For information on G-E's complete line of portable a-c high-potential test sets, write for Bulletin GEA-4477, *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

411-55

VACUUM TUBE VOLTMETER

MODEL 62

SPECIFICATIONS:

RANGE: Push button selection of five ranges—1, 3, 10, 30 and 100 volts a.c. or d.c.

ACCURACY: 2% of full scale. Useable from 50 cycles to 150 megacycles.

INDICATION: Linear for d.c. and calibrated to indicate r.m.s. values of a sine-wave or 71% of the peak value of a complex wave on a.c.

POWER SUPPLY: 115 volts, 40-60 cycles—no batteries.

DIMENSIONS: 4¾″ wide, 6″ high, and 8½″ deep.

WEIGHT: Approximately six pounds. *Immediate Delivery*

MANUFACTURERS OF
Standard Signal Generators
Pulse Generators
FM Signal Generators
Square Wave Generators
Vacuum Tube Voltmeters
UHF Radio Noise & Field Strength Meters
Capacity Bridges
Megohm Meters
Phase Sequence Indicators
Television and FM Test Equipment

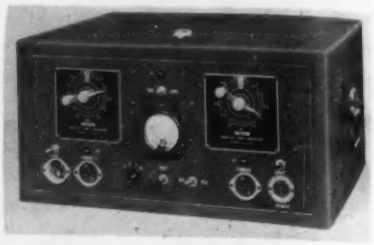
MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

dicator permits operation at constant rate of loading if desired, instead of a constant rate of elongation. At least 6″ per minute is available at full load. Standard eye-spliced specimens can be tested on this machine by fastening pins to the chucks or, when testing lighter rope, by means of capstans bolted to the chucks. Three load ranges are provided: 0 to 6000 lbs., 0 to 24,000 lbs., and 0 to 120,000 lbs., each being read to an accuracy of 0.5% on a 66″ scale. — *Baldwin Locomotive Works, Philadelphia 42, Pa.*

Please mention number 1040 when filling out card

Automatic Time Controller

New "Model J-410" automatic control unit is especially designed for use with "Fastax" cameras. Synchronizes



camera to sequence of events to be photographed, allows remote control operation of both event and camera, doubles picture-taking speed of camera, controls film speed. Built-in variable-transformer controls voltage to camera from 0 to 270 volts, making speed range of camera infinite. Each timer has time cycle of from 5 cycles to 5 secs. and will control sequence of events to camera operation in any of 8 different positions.—*Industrial Timer Corp., 115 Edison Pl., Newark 5, N. J.*

Please mention number 1041 when filling out card

Pressure Switch

New "Hy-G" pressure switch, so named because of its ability to withstand high surge pressures and up to 20 *G*'s of vibration, incorporates 20-amp. inductive low-pressure sensitivity and differential adjustment; is especially adaptable to aircraft applications where critical operating and differential adjustments are required. Its low differential and high amperage settings also make it adaptable to industrial pressure control applications. Dimensions are 4¾″ × 2⅝″ × 1-9/16″, and location of pressure and amphenol electrical connections is optional to suit user's requirements. Weight of standard model is less than 11 ounces. Features of the "Hy-G" are: stable

PRECISION REGULATION

WITH CONO MODEL H-10 MANUAL LOADING REGULATOR

Range 0-5 psi.

- A precision-built reducing-relief valve, especially designed for manual loading service.
- Sensitive to within one-tenth of an inch of water.
- Stable and free from any tendency to "drift."
- Not affected by upstream pressure variations.
- Forged brass construction with stainless steel trim.
- Available in standard ranges 0-5 psi, 0-25 psi, 0-50 psi with 1/4" pipe taps.
- Price $8.50

Write for Bulletin PH-10

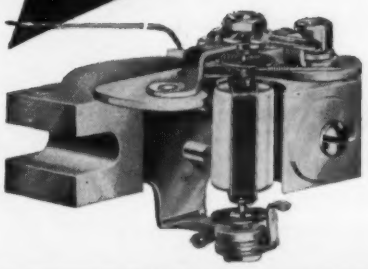
CONOFLOW CORPORATION
2100 ARCH ST., PHILA. 3, PA.

INDUSTRIAL PNEUMATIC Cono-Controls

ONE OF A SERIES

BALANCE WEIGHTS

WHY BURLINGTON PANEL INSTRUMENTS PROVIDE UTMOST RELIABILITY . . .



BALANCE WEIGHTS of helical type phosphor bronze, formed in a manner which eliminates slipping or shifting, are used to balance the moving element. All ranges AC and DC available in 2½", 3½", 4½" rectangular or round case styles and are guaranteed for one year against defects in workmanship or materials. Refer inquiries to Dept. H108.

Burlington INSTRUMENT COMPANY
BURLINGTON, IOWA

Measure Frequencies

- ***INSTANTLY*** ... direct reading. No computation.
- ***ACCURATELY*** ... to a frequency determination of 0.05%.
- ***VISUALLY*** ... at the turn of the dial indicator knob.

Used effectively in leading laboratories, such as: Harvard University, Bell Aircraft Corp., and Hamilton Standard Propellers ... for measuring natural frequencies or speed of rotating objects, checking or calibrating tachometers, oscillators, impulse generators, similar equipment.

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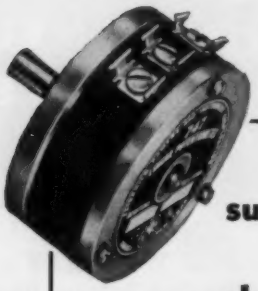
Fairchild Precision Potentiometers



long life
sustained accuracy
low noise level
absolute resolution
resetability
multiple ganging

For further information address: Dept. 'K', 88-06 Van Wyck Boulevard, Jamaica 1, New York

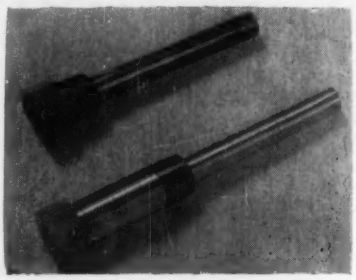
Fairchild CAMERA AND INSTRUMENT CORPORATION

through temperature range from —65°F. to +160°F.; relay permits multiple switching circuits, and 4 form "C" contact arrangements with suitable amphenol terminals can be provided. Contact arrangements are normally provided s-p.s-t. or s-p.d-t. double make or break; restraining plates permit diaphragm capsule to accommodate high surge pressures without distortion or effect on adjustment; changing thickness of diaphragm and restraining plate enables operating pressure range to be varied from .1" H_2O to 30 lbs./in.^{2}; 28 volts d.c. are switched by the standard "Hy-G," but a.c. can be handled by changing relay and terminals. For high altitudes or other circumstances where switching characteristics may be affected, the "Hy-G" can be supplied "Stratopaxed" by maker's method of hermetic sealing in a neutral gas atmosphere.—*DiaPHlex Div., Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill.*

Please mention number 1042 when filling out card

Thermocouple Wells

New protective thermocouple wells of ferrous and non-ferrous metals are

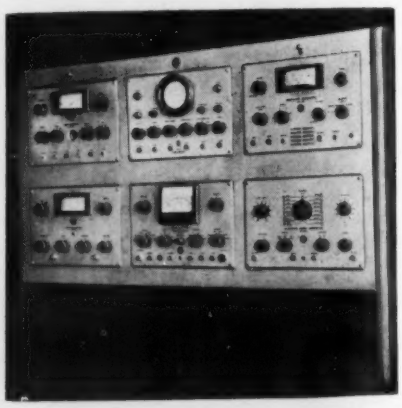


drilled, turned and threaded to specifications supplied by manufacturers or wholesalers.—*Capewell Manufacturing Co., 624 Filbert St., Philadelphia, Pa.*

Please mention number 1043 when filling out card

Radio Test Equipment Rack

New "WS-16A" test equipment rack, designed for any six of maker's matched units of test and measuring



equipment, serves both to display test equipment and as an efficient service rack. Designed for mounting on top of a workbench, new rack accommodates six pieces of equipment in two rows with a flush-fitting front panel which exposes only faces of equipment.—*RCA Victor Div. Radio Corp. of America, Camden, N. J.*

Please mention number 1044 when filling out card

Solving New Battery Problems is a BURGESS SPECIALTY

When battery specifications and performance requirements are most exacting, engineers insist on BURGESS. The wide range of uniform, high quality dry batteries for electronic applications is available only at Burgess, and is the result of over *thirty* years of patient dry battery research by engineering experts.

No. 4FH. Delivers 1½ volts for popular industrial applications.

BURGESS Engineering Service Free

Burgess Services—Design, Engineering, Production—are at your disposal to provide the battery you need! Send for free "Check Sheet" to outline your requirements!

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BATTERY COMPANY · FREEPORT, ILLINOIS

ELEMATIC THERMOCOUPLE

MODEL 4000 — for wall type indicator or recorder. Has flexible arm adjustable to any angle without use of tools

For Instantly and Accurately Checking the Temperature of all Nonferrous Molten Metals

"METALAST" SPEEDY

tips are made of a special heat-resisting alloy which will give SPEED plus DURABILITY plus ACCURACY.

METALAST SPEEDY JUNIOR—¼" pipe size, for quick response—thermocouples are made of 16 gauge wire.

METALAST SPEEDY STANDARD—½" pipe size, heavy duty—thermocouples are made of 8 or 11 gauge wire.

Tubes may be straight, as well as 45 or 90 degree angles.

REPRESENTATIVES WANTED

For further information—write to

ELEMATIC EQUIPMENT CORPORATION

1150 W. MARQUETTE ROAD CHICAGO 21, ILLINOIS

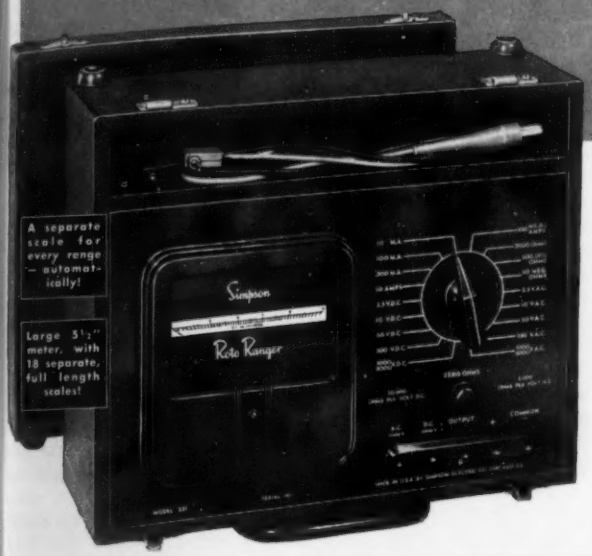
NEW! ... the Roto Ranger

— automatically rotates one of 18 separate scales into position as you select the range.

Here is the only multiple scale test instrument of its kind in the world. It definitely reduces the possibility of errors by providing a single scale for each range of this finest of volt-ohm-milliammeters. As the selector switch is moved to the range desired, an ingenious gearing mechanism rotates a drum, bringing into place behind the meter window the proper scale for that range. Here is the equivalent of 25 separate instruments combined in one sturdy and compact unit. (18 scales; 7 additional direct reading ranges through use of high voltage and output jacks.) The patented Roto-Ranger principle eliminates the confusion of numerous readings on one scale, and the multiplying factors common to ordinary multi-range testers, by providing a separate scale for each range. There are no cramped calibrations in these full sized Roto-Ranger scales. Each is designed as it would be for a separate instrument.

Ask your jobber, or write for literature

Simpson Model 221 Roto-Ranger High-Sensitivity A.C.-D.C. Volt-Ohm-Milliammeter



RANGES

Model 221 Volt-Ohm-Milliammeter

20,000 Ohms per Volt D.C., 1,000 Ohms per Volt A.C.
Volts, A.C.: 2.5, 10, 50, 250, 1000, 5000
Volts, D.C.: 2.5, 10, 50, 300, 1000, 5000
Milliamperes, D.C.: 10, 100, 500
Microamperes, D.C.: 100
Amperes, D.C.: 10
Output: 2.5, 10, 50, 250, 1000
Ohms: 0-2000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center).
Size: 12¾" x 10⅛" x 5⅜"
Weight: 8 lbs. 9 oz.
Price, complete with test leads and 28-Page Operator's Manual $69.85

High voltage test probe for TV, radar, x-ray and other high voltage tests, also available.

Simpson
INSTRUMENTS THAT STAY ACCURATE

SIMPSON ELECTRIC COMPTNY
5200-5218 W. Kinzie St., Chicago 44, Ill.
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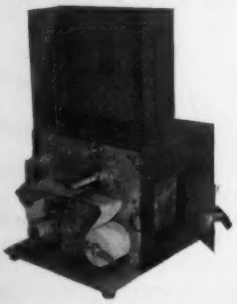

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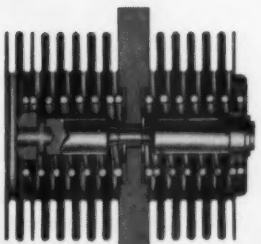

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PART IV

POWER FACTOR METERS

Circular-scale power factor meters are designed to indicate directly the power factor of a-c. circuits of commercial frequencies. They serve a purpose which would otherwise require at least one ammeter, voltmeter and wattmeter plus calculations of the power factor from their indications.

The circular-scale power factor meter operates on the rotating iron vane principle, a polarized movable iron vane being located within the effective area (see Figs. 1 and 2) of a rotating electrical field. The three-phase stator winding is connected through resistors to the three-phase circuit to be measured (see Figs. 10, 11 and 12) and the polarizing coil is connected in series with one leg of the circuit. From this it can be seen that the iron vane is magnetized by the polarizing coil whose current is taken from one leg of the circuit being measured. Under these conditions, the moving iron will be attracted or repelled by the rotating field and will assume a position where the zero of both the rotating field and the polarizing coil field occur at the same instant. This then leads to the conclusion that the vanes

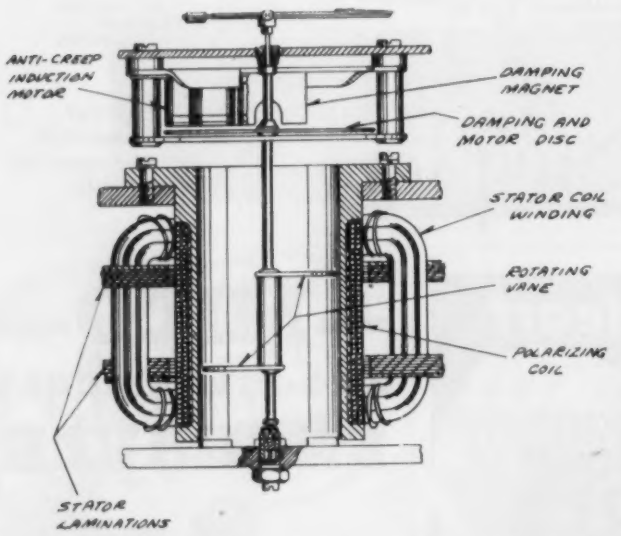

Fig. 1. Schematic view of the mechanism of the Westinghouse power factor meter and synchroscope.

will always take a position indicating the phase angle between the voltage and current of the circuit. Since the pointer is mounted on the shaft carrying the iron vane, it changes its position simultaneously with any position change of the vane. Hence the pointer indicates, on a calibrated scale, the cosine of the phase angle, or the power factor.

The rotating field of the single-phase instrument is made possible by a split-phase arrangement of the voltage circuit. Three-phase meters have a stator whose coils are spaced 120 degrees apart with each coil connected to one phase of the circuit being measured. Single-phase meters have the same coil arrangement but are connected to the line through a phase-splitting arrangement of resistor, reactor and capacitor (see Fig. 5) to get the rotating field effect.

The effective damping of these instruments is the result of an aluminum vane on the shaft of the element moving in the field of a strong permanant magnet (see Figs. 1 and 2).

These instruments are an improvement on those of the past in that they include an anti-creep mechanism. This mechanism is in reality a miniature three-phase induction motor (see Fig. 1). Its purpose is to oppose any tendency of the moving vane to follow the rotating field when the polarizing coil of the power factor meter is operating below its normal current rating.

Construction

The construction of the KI-24 circular scale power factor meter and that of the synchroscope of this type are identical as regard mechanical details. Therefore, the following outline of dismantling operations and the illustrations should serve as an explanation of the construction details of the power factor meter and of the synchroscope.

As would be expected, the first operation in dismantling these instruments is to remove the cover and case. This operation was explained under d-c instruments.

In order to detach the dial, the pointer must be removed. The pointer is held tight on the element shaft by two set screws through the pointer hub and then four dial screws must be removed to dismount the dial.

The magnet assembly (see Fig. 6) is next dismounted by removing the four screws holding it to the top plate, cutting the cord holding the magnet coil leads in place and removing the lower screw holding the top plate to the frame. With the removal of the lower top plate-to-frame screw, the spacer bushing can be taken out and the magnet assembly may be slid from its position. Care must be exercised when sliding the magnet assembly from its position to avoid bending the damping disk.

Before attempting to remove the top plate, the top bearing should be loosened to avoid damage to the pivots. The remaining three screws holding the top plate-to-frame are removed, after which the plate should be raised straight up to clear the top pivot when removing. This operation calls for extra care to guard against bending the element shaft or ruining the pivot. A good method to follow for this operation is to loosen all three screws before removing any one, so as to avoid shifting the plate while applying pressure in loosening the last screw.

To remove the moving element (see Fig. 7) from the mechanism (Fig. 8) it is necessary to detach one of the T-shaped bumpers mounted on the flanged end of the polarizing coil bobbin.

Dismounting of the polarizing coil (See Fig. 9) necessitates the removal of the eight screws in the flanged end of the coil bobbin. With the removal of these screws and disconnecting the coil leads from the terminals, the coil may be lifted out of its housing.

The base is detached from the instrument by removing the four nuts on the stator mounting studs. The lead connections from the stator, polarizing coil, anti-creep coils and resistors are accessible with the removal of the base. The resistance cards are mounted, connected and covered in a similar manner to that of the wattmeter of this type.

While the two makes of power factor meters being discussed are similar in their operation, they differ in construction as can be seen by comparing the illustrations of their various parts.

The relative positions of the various parts of the AB-12 meter as shown in Figs. 3 and 4 should aid considerably in following the word picture of the construction details of this instrument.

The case, cover, dial, magnets, magnet ring and base assembly are similar in construction and assembly as the like parts of the a-c voltmeter shown in Figs. 2 and 3 of voltmeters.

The mechanism of this instrument is mounted in a two piece frame (See Figs. 3 and 4) that also serves to mount the mechanism on the base and as a mounting for the top bridge, magnet and magnet ring. To disassemble this mechanism, the three screws holding the front and rear parts of the element frame must first be removed to permit the separating of the stator section from the element and field coil housing. The stator can then be removed from the rear element frame. The rear jewel screw is assembled in the Y-bridge section of the lower bridge.

With the separation of the upper and lower element frame, the movement is free from between its jewel assembly. The upper pivot, however, projects through the ring jewel in the top bridge. To dismantle this part of the assembly, the pointer attached to this top part of the shaft by set screws and the top bridge must be detached (two screws). A set screw holds the lower armature vane to the shaft. With the loosening of this set screw the lower vane can be detached from the shaft, allowing for the removal of the shaft from the field-coil assembly.

Inspection and Test of KI-24 and AB-12 Instruments

In outlining the calibration adjustments of the circular-scale power factor meter, it must first be explained that there are two types. The two types differ however only in that one is connected and has an adjustment for correcting creep, if this fault presents itself.

The first type, that is the one minus the anti-creep adjustment, is easy to calibrate or adjust in the field. As with all instruments, it should first be given a thorough mechanical check-up before any electrical adjustments are attempted. This check-up should cover connections, clearance of moving parts, end play, mechanical balance, internal cleanliness of parts and dust-proof features. The resistances in series with each leg of the stator as shown in Fig. 11 are attached to the back of the instrument and should be of approximately equal value.

Calibration adjustments are made with the instrument connected to a three-phase line as shown in Fig. 11, using a suitable standard as a comparator. With the circuit

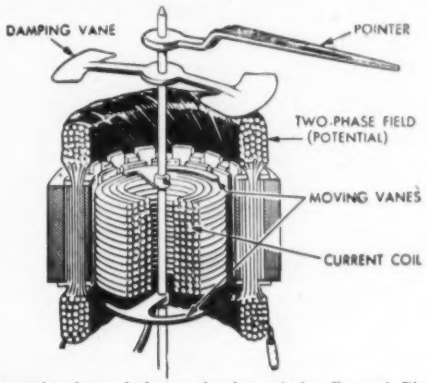

Fig. 2. Schematic view of the mechanism of the General Electric AB-12 power factor meter.

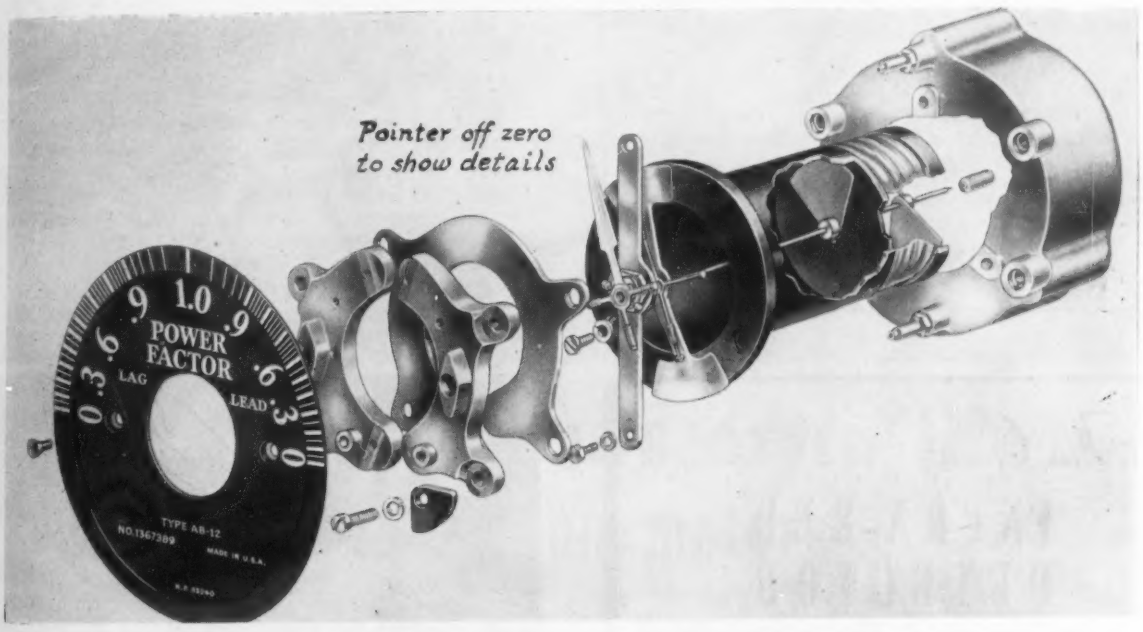

Fig. 3. Exploded view of the General Electric AB-12 power factor meter.

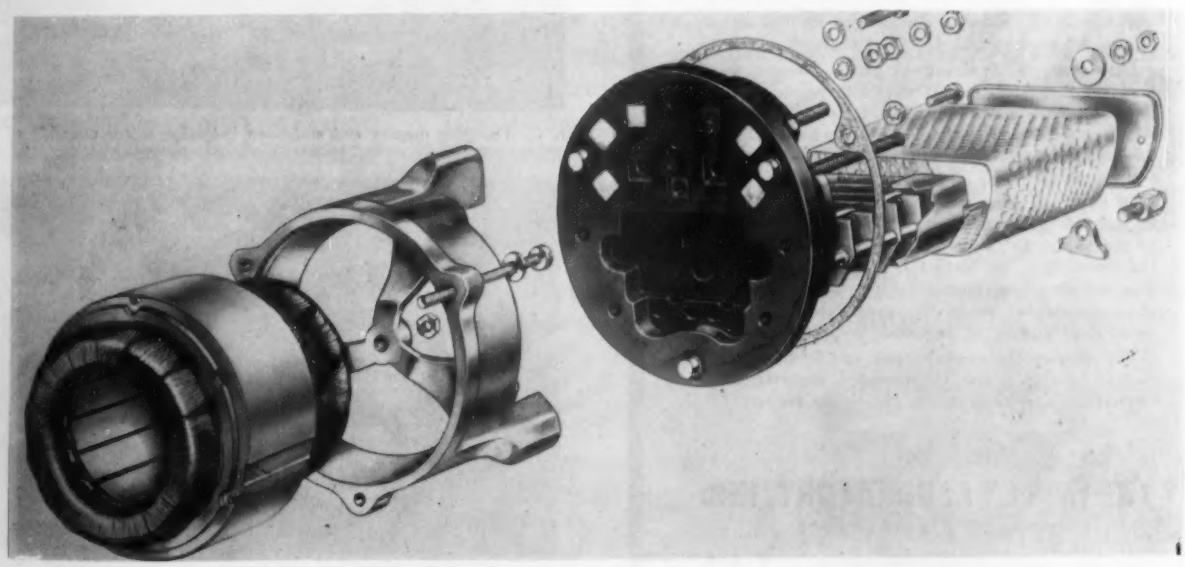

Fig. 4. Details of the General Electric AB-10, AB-12 and AB-13 instruments.

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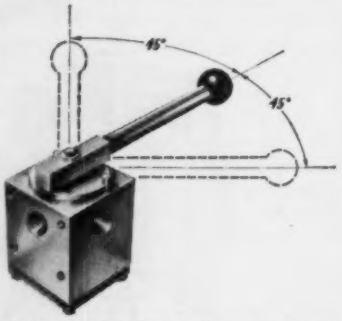

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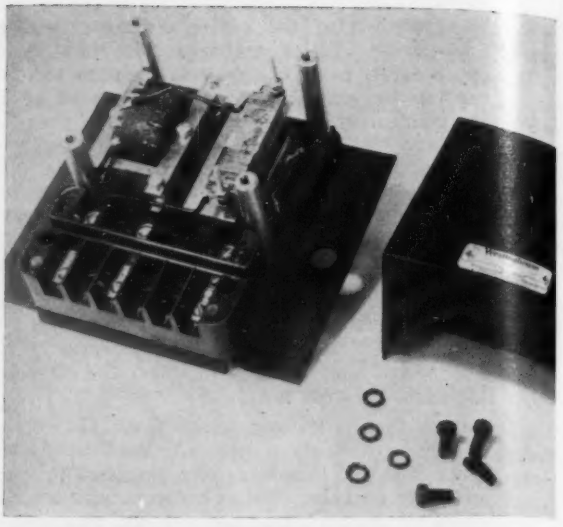


Fig. 5. External resistor-reactor-capacitor of the single-phase Westinghouse I-24 power factor meter with cover removed.

adjusted to unity power factor, the pointer should be set at the 12 o'clock position when rated voltage and seventy per cent of rated current are applied. This adjustment is made by loosening the set screws holding the pointer to the shaft, moving the pointer to the 12 o'clock position and retightening the set screws. The power factor should then be changed to zero lag and then to zero lead and both these points marked on the dial.

These three points (0-100-0) are then checked for balance by reducing the current to forty percent of rated value and then raising the current to one hundred percent of rated value. The instrument should be balanced (shifting balance weight) so that the pointer stays within one percent of any of these points when the power factor is set for the point being checked.

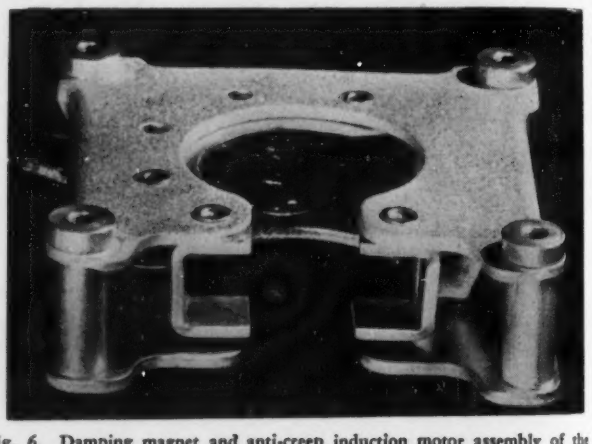


Fig. 6. Damping magnet and anti-creep induction motor assembly of the Westinghouse KI-24 power factor meter and synchroscope.

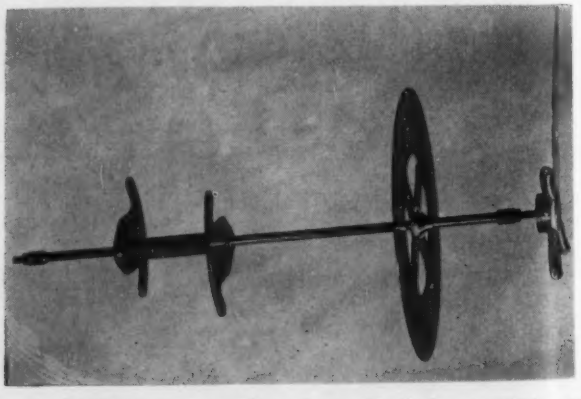
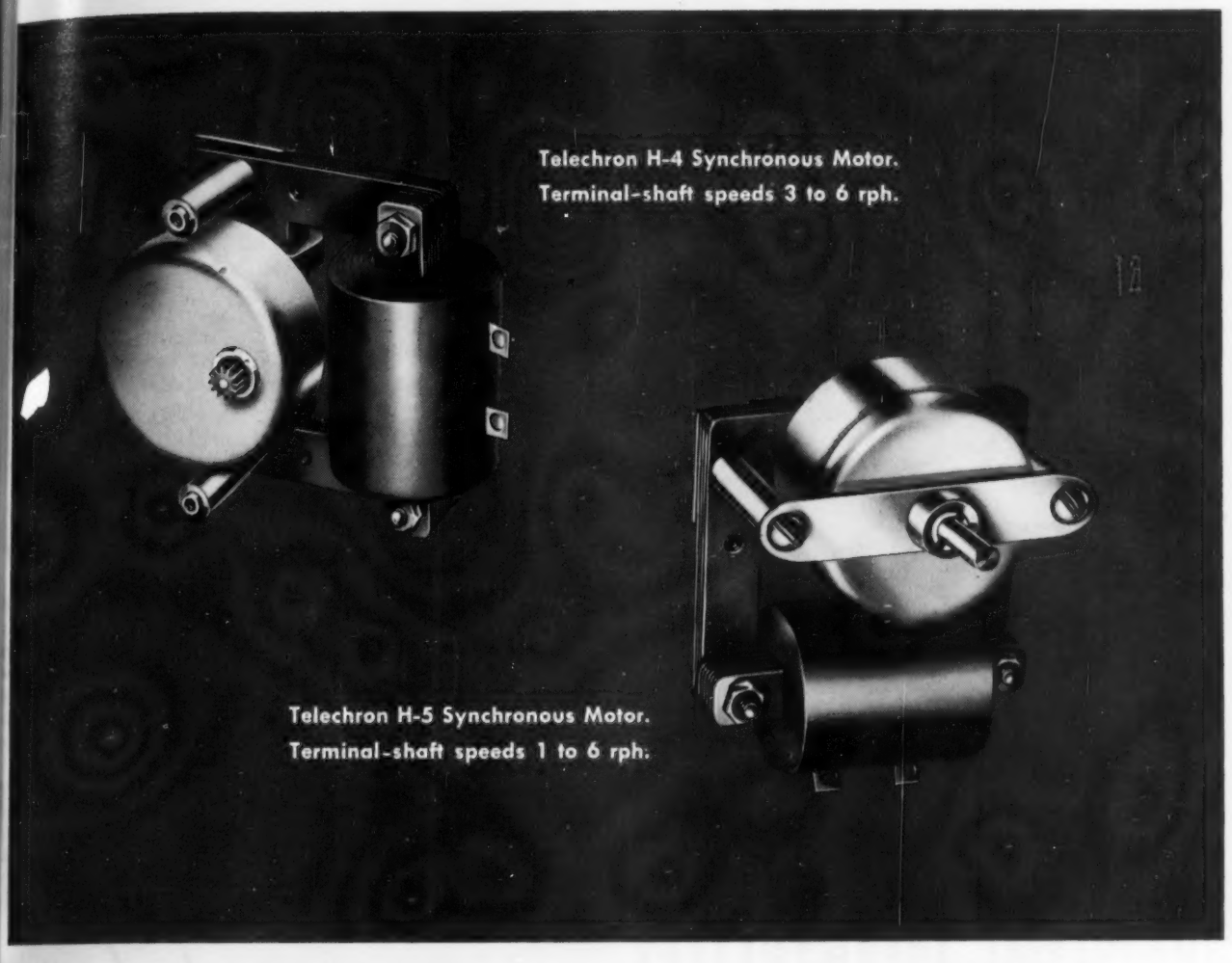


Fig. 7. Moving-element assembly of the Westinghouse KI-24 power factor meter and synchroscope.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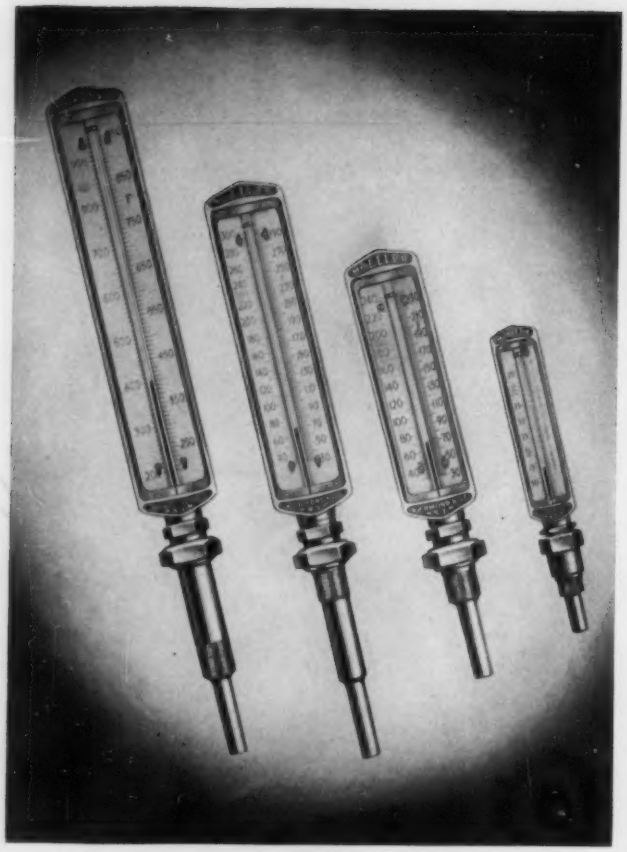

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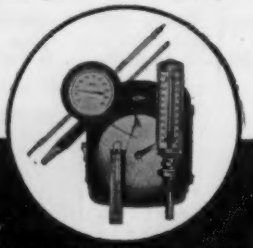

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The instrument should next be checked face up with voltage only applied to ascertain that the pointer does not rotate (creep). These instruments are compensated at the factory to eliminate creep; therefore, no evidence of this characteristic should present itself. If, through accident or other cause, a derangement of parts takes place and creep becomes apparent, a slight change of resistance in one leg (usually the top set of cards) of the stator will correct this fault.

The second type (the one having the anti-creep adjustor) is connected for test as shown in Fig. 12. With rated three-phase voltage and seventy percent of rated current applied at unity power factor, the pointer should be set at the 12 o'clock position. The voltages across each phase of the stator should next be checked and balanced to within plus or minus one-half volt of each other by adjusting the resistors in series with each leg of the stator. These voltages should be checked for equality as follows:

1. Voltage across *A* and *B* with pointer in the 12 o'clock position.
2. Voltage across *A* and *C* with the pointer rotated 120 degrees counter-clockwise from 12 o'clock position.
3. Voltage across *B* and *C* with the pointer rotated 120 degrees clockwise from 12 o'clock position.

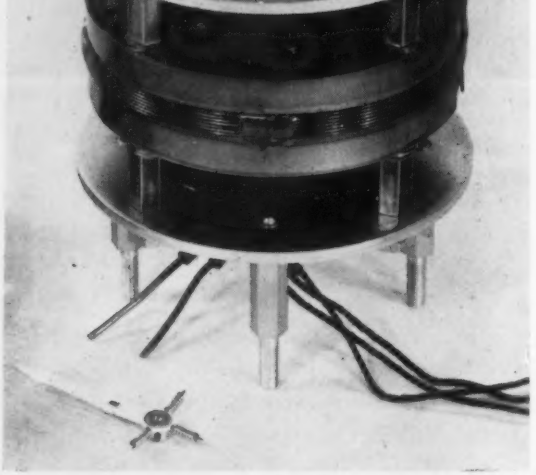

Fig. 8. Mechanism of the KI-24 Westinghouse power factor meter.

A convenient method of making these adjustments is to use variable resistors such as decade boxes and, when resistances are determined, cut in the permanent resistors.

Creep is checked and adjusted with the instrument in the face-up position. With voltage only applied to the instrument the resistor in position *B* should be adjusted to overcome creep.

Mechanical balance is adjusted as follows: With the instrument in the face-up position, the zero lag and zero lead points should be adjusted to approximately 90 mechanical degrees from the 12 o'clock position. The pointer is set to these positions (zeros) by loosening the set screws on the pointer hub and shifting the pointer as required. When making these adjustments, rated voltage and 70 percent rated current should be applied with the power factor of the circuit first at zero lag and then at zero lead. With the instrument in its normal operating position and the circuit operating at unity power factor, rated voltage and 20 percent of rated current should be applied and the point of

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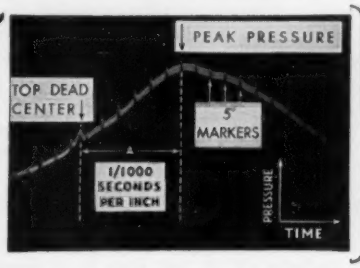

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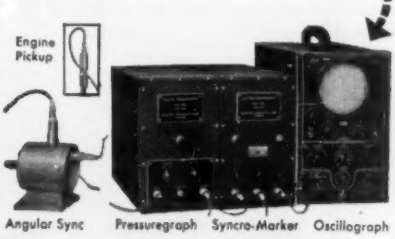

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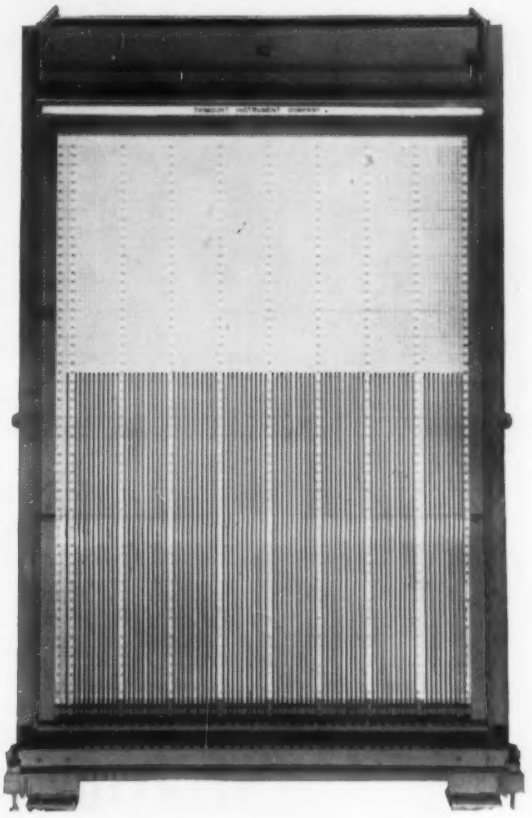

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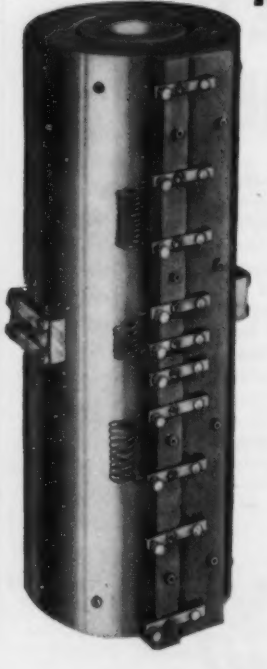

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indication noted. The instrument should then be rotated s degrees in either direction and the balance adjusted (b balance weights) to stay within one percent of the unit point.

The instrument should now be connected to a test circu with a suitable standard, full rated voltage and 70 percen of rated current applied and all calibration points checked

Single-phase power factor meters are connected as in Fig. 10 and are calibrated by selecting the correct tap on th reactor and adjusting the resistance in the impedor.

Maintenance

While it is not claimed that the circular-scale type is th discovery of the perfect instrument, it can be said that from a maintenance and service point of view it is far superior t past designs. With all this improvement claimed for thi instrument, however, there are certain do's and don'ts tha must be followed. For example, as with all instruments this type must be properly applied, carefully handled an installed and serviced or repaired only by persons qualifie by experience to do this work.

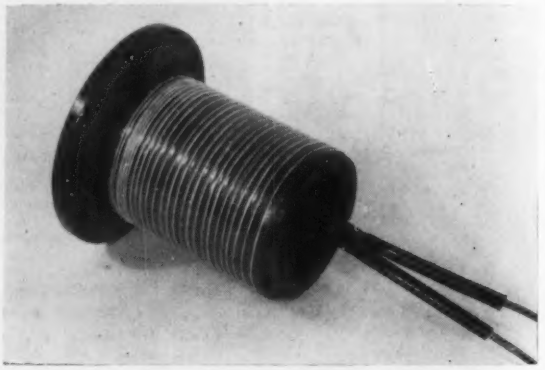


Fig. 9. Polarizing coil of the KI-24 Westinghouse power factor mete

A few of the possible faults of the circular-scale powe factor meter and synchroscope are: *friction, defective resi tors, open circuits, short circuits, poor connections, unbal anced phases, observational errors, and defective balance.*

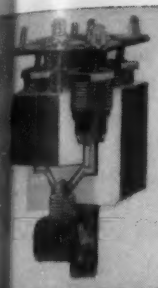
Friction in the circular-scale power-factor meter an synchroscope is not considered a major fault as in othe instruments. This favorable condition may be attributed t the special design of pivots and jewels, large clearance o moving parts, improved materials and high torque. If fric tion should present itself however, a few points to check ar end play, disk clearance, pointer-to-dial spacing, distorte moving parts, pointer loose on shaft, pivot loose in shaft etc. When checking or adjusting end play, be sure to con sider the spring action of the jewel so that it is not mis taken for free end-to-end movement of the shaft.

If the power factor meter does not indicate correctly an it is necessary to shift the pointer, be sure that the pointe set screws are loose before attempting to move the pointer Since the pivots of this element are pressed in the shaft, an as the pointer set screws are tightened against the shank of the pivot, any attempts to shift the pointer when the se screws are tight may loosen the pivots in the shaft.

Balance is an important item to check when calibration errors are found in either power factor meters or synchro scopes. Balance can be corrected as outlined under "test" by shifting the balance weights as required. It has been found by experience that slight errors of calibration in power-fac tor meters and synchroscopes can in a majority of cases b corrected by balance adjustments.

Owing to the nature of polyphase circuits, power factor meters for three-phase measurement of system power factor are calibrated on balanced circuits. In view of this, it i well to check the system voltages for balance if the power factor meter indicates incorrectly. Any unbalance of volt ages will affect the system power factor indication. Loose connections, for example, may cause sufficient voltage drop in one phase to affect the system power factor indication.

If, after connecting a polyphase power factor meter t



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GAS SAMPLE NO.	PERCENT H_2 BY VOLUME Conductivity Cell	Orsat
70	67	66
71	55	55
72	51-57	55
73	60	60
74	not det'n	65
75	68	67
76	59	60
77	56	55
78	61	60
79	58	57
80	52	52
81	60	60
82	65	64
83	56.5	56
84	67	65
85	65	66
86	61	60

In general, H_2 determined by this method in "tail" gas from a Fischer-Tropsch unit using a cobalt catalyst checks the value determined by the "Orsat" technique within 1 percent.

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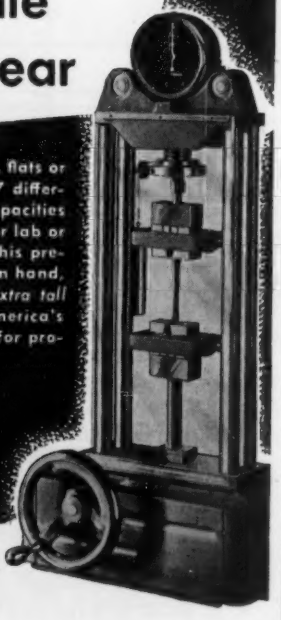

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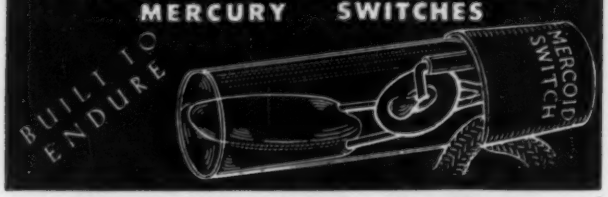

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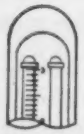
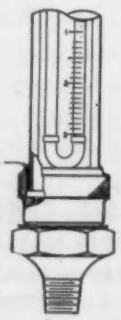


1. Does not pull loose under vibration in service.
2. Not dissolved out by various vapors to which subjected in use.
3. Leak tight joint ready for test immediately after setting.
4. Dome breakage eliminated.
5. Less skill required for assembly.



Cerroseal-35, an Indium solder, adheres directly to clean smooth glass, mica and some ceramics. Bonds to same metals as ordinary solders. Working temperature — approximately 260°F. on glass—ideal for hermetic seal of glass dial covers on delicate instruments, vacuum seals in glass laboratory apparatus, etc.

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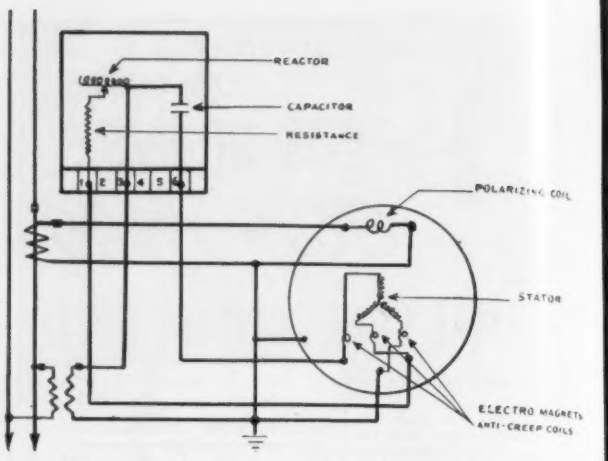

Fig. 10. Internal and external connections of single-phase power factor meter.

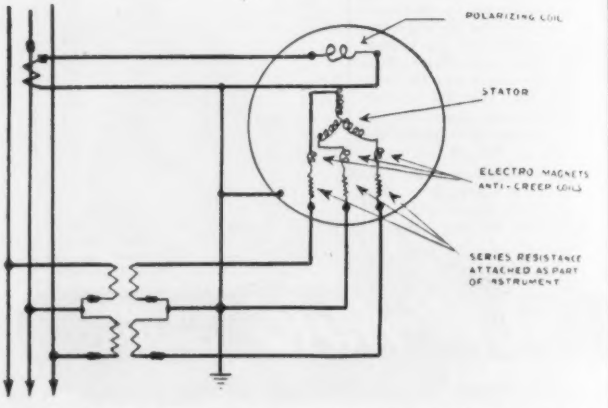

Fig. 11. Internal and external connections for polyphase power factor meter.

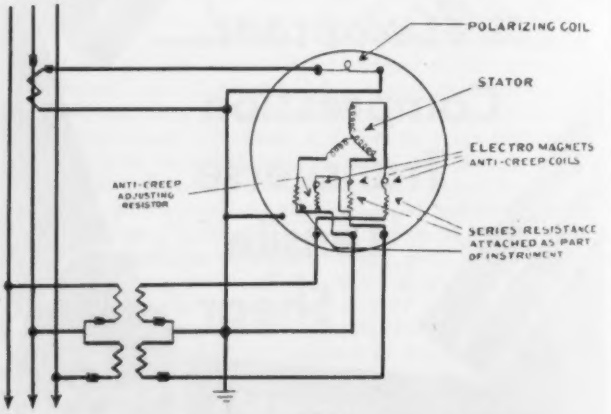

Fig. 12. Internal and external connections for polyphase power factor meter with anti-creep adjustment.

the line, there is any question as to the connections, a check may be made by shortening the current terminals. With the current terminals shorted, the pointer should move to the lag side (counter-clockwise). If the pointer moves clockwise, the phase sequence is wrong, and the connections to the instrument terminals should be interchanged to correct this condition.

As a guide in ascertaining the correct connections, the following notes are given. With the instrument connected to the line to be measured and rated current and voltage applied, the conditions outlined below will hold true:

1. If the current connections are reversed, the pointer indication will be 180 degrees away from the actual power factor of the system.

2. If leads to terminals *A* and *C* are reversed, the instru-

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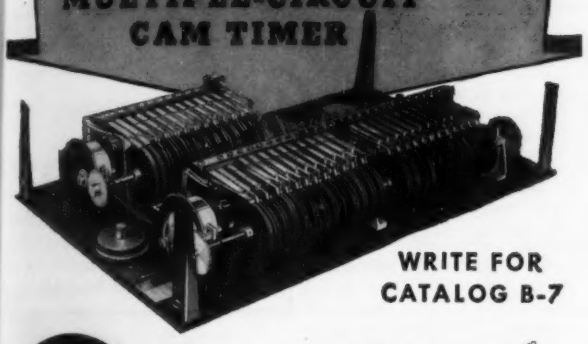

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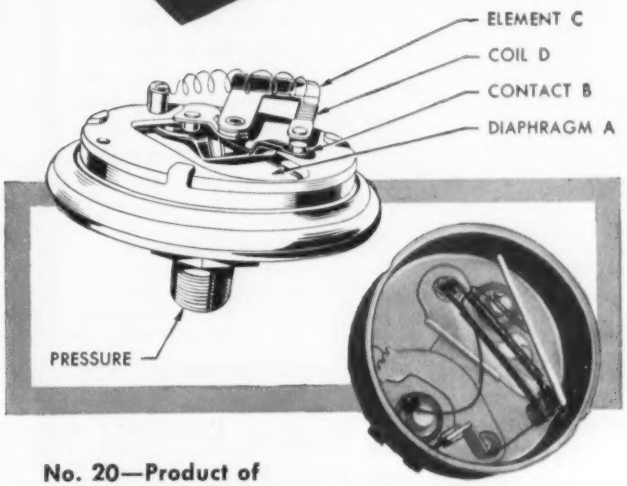

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This electric oil pressure "Telegage", manufactured by King-Seeley Corporation illustrates a use of thermostatic bimetal known as the "double bimetal circuit". Diaphragm A is subjected to the engine oil pressure. The diaphragm movement forces grounded contact B against the insulated contact on the "U" shaped bimetal element C. As the current flows through the circuit, the coil D heats the element, causing it to bend back, opening the contacts momentarily. The bimetal cools in an instant and again the contacts close.

The dash unit encloses a similar bimetal element and coil. Since both heater coils are in the same circuit, a similar bending of the bimetal occurs and the linkage moves the needle accordingly. When oil pressure increases, the bimetal element C is heated more in order to open the contacts; and this same increased heat causes a greater movement of the needle.

This precise and reliable use of Chace Thermostatic Bimetal as the actuating element in a heat responsive device is typical of the products of W. M. Chace Company. Your problem in temperature control, indication or protection will receive thorough attention.

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ment indication will be a few percent to the lag side of the correct point.

3. If *B* and *C* connections are reversed, the pointer will take a position in the lower left (lead) quadrant of the dial.

4. If *A* and *B* connections are reversed, the pointer will indicate in the lower right (lag) quadrant of the dial.

When an instrument reading is 120 degrees away from the actual reading (three-phase instrument), the connection to the potential terminals *A.B.C.* should be rotated to *C.A.B* or *B.C.A.*, whichever produces the correct reading. If one of these settings results in an indication 180 degrees away from the actual reading, the current connections should be reversed.

If one of the voltage windings of the polyphase power-factor meter is open circuited, the pointer will remain at the same point at all times regardless of variations of power factor. An open circuit in the winding of a single-phase meter will be indicated by either an indication at approximately 60 percent lead if the inductive circuit is open or an indication at approximately 60 percent lag if the capacitive circuit is open.

Maximum accuracy is obtainable when current is from 40 to 125 percent of normal value and voltage is from 75 to 125 percent of normal.

(To be concluded)

Symptom: Instrument Fails to Indicate

POSSIBLE DEFECT	
MECHANICAL	ELECTRICAL
Pointer sticking	Open coils
Element out of jewels	Open resistance
Pivots tight in jewels	Loose connections
Damping vane sticking	No external circuit
Damping disk lying on magnet	Shorted coils
Broken pivots	Opposite polarities in divided stationary coil
Coils sticking due to foreign matter between coils	Shorted transformer
Coils warped	Open in transformer winding
Loose wires	
Misplaced coil cement	
Cross arms caught on adjacent parts	

Symptom: Instrument Indicates Incorrectly

POSSIBLE DEFECT	
MECHANICAL	ELECTRICAL
Friction—Static or rolling	Poor connections
Sticking up scale	Grounds
Off balance	Partly shorted coils—series resistance or shunt
Spring convolutions touching	Reverse polarity (Wattmeter)
Bent pointer	Wrong connections
Zero shift	Open shunt
Spring set	Temperature error
Loose spring connections	External field effects
Loose pointer	Magnetized metal cases
Loose pivots	Steel panel mounting
Loose jewels	Frequency error
Pointer not passing full-scale or zero	Distorted coils
Too much or not enough end play	Field effects between elements
Dial or element shift	
Parallax	
Coils rubbing	
Damping vane rubbing	
Tail weight hitting zero adj. pin	
Pointer touching dial or glass cover	
Pointer shaft touching coil	
Spring touching adjacent parts	
Damping disk touching magnet	
Element shaft touching damping chamber cover	
Annealed springs	

TROUBLE CHART FOR A-C. INSTRUMENTS

JOURNAL of the Instrument Society of America

Editor, H. L. HILDENBRAND, Box 35, Onarga, Illinois
I.S.A. National Office, 1117 Wolfendale St., Pittsburgh 12, Penna.

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A. O. Beckman, V. Pres.

Vol. 3 — October 1948 — No. 10

Greetings from Our New President

To greet the membership of the Instrument Society of America through the columns of the I.S.A. Journal is one of the prerogatives and privileges of a newly-elected president. I am happy to avail myself of this opportunity and to pledge myself in every way to further the objectives, growth and prestige of the Society. In this goal I know I shall have the sustained support of the entire membership, and particularly of the Executive Committee who constitute a cross-section of distinction in the instrument field, both from the technical and administrative point of view.

The Society represents the many phases of instrument activity in both the industrial and the scientific fields. Under the leadership of your past administrations, its structure has been under continuous development. At the present time we have a committee framework that admirably covers the broad fields of interest, from industrial instruments for measurement and control, at one end, to purely research instruments at the other end. We must be mindful, it should be emphasized, of the rapid development of instrument technology, and mindful of the accelerated pace of the modern age in which the research techniques of today become the industrial practices of tomorrow.

In the committee structure of the Society there is a wide-spread opportunity for active participation on the part of members of every designation—from the instrument maintenance man, from the technical engineer, right on through to the laboratory technician and to the research scientist. We are therefore issuing a call for suggestions of names of members who would be well qualified to serve in available posts on committees. Thus we shall be able to set up a roster of possible committee men within the Society from which personnel for our future activities may be drawn. It is the work of our committees that forms the foundation of our future development, and for which we justifiably have high hopes.

I am personally very happy to greet you in this way and look forward indeed to meeting more and more of the membership.

CARL F. KAYAN, *Pres.*

OFFICERS AND EXECUTIVE COMMITTEE MEMBERS

President: Carl F. Kayan, Professor of Mechanical Engineering, Columbia University, New York 27, N. Y.

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J. B. McMahon, Republic Flow Meters Co., 2240 Diversey Parkway, Chicago 47, Ill.

Dr. A. O. Beckman, President, National Technical Laboratories, Pasadena, Calif.

Treasurer: H. E. Ferguson, Plant Testing Engineer, Peoples Gas Light & Coke Co., 45 Pershing Road, Chicago, Ill.

Executive Secretary: Richard Rimbach, President and Business Manager, Instruments Publishing Co., 1117 Wolfendale St., Pittsburgh 12, Pa.

Executive Committee Members: Paul Exline, Exline Engineering Co., 710 S. Troost St., Tulsa 5, Okla.

H. H. Barnum, H. H. Barnum Co., 16554 Pierson St., Detroit 19, Mich.

Lyman H. Allen, American Viscose Corp., Philadelphia, Pa.

In this roster of officers and exective committee members, Dr. A. O. Beckman and Lyman H. Allen are new. We will publish short biographies in Who's Who as soon as possible.

1948 ANNUAL MEETING

The annual meeting on Wednesday, Sept. 15th was not as well attended as it should have been, so this report is written both for those who attended the Conference and those who did not. President Exline opened the meeting by introducing the officers and executive committee members. He then read his report, which was the same report read to the Board of Directors on Saturday, Sept. 11th, plus the positive actions on motions made in the Directors' meeting. The following is a resume of what happened plus excerpts from the reports:—

"The third year of the Instrument Society of America showed a healthy growth in sections and membership. The groundwork has been prepared for marked improvement in Society structure as an aid to its future development. Recognition by representatives of the instrument industry has indicated the acceptance of ISA as the chosen representative of the instrument user. Cooperation by professional societies has increased by addition of AIEE and AIP as participating Societies in the third National Conference.

"Special mention should be made of the activities of the Executive Committee who by their responsible and able contributions have materially aided in the development of this young Society. Outstanding contributions have also been made by the Recommended Practices Committee under the chairmanship of J. G. Kedley and with the enthusiastic assistance of an unusually large number of members.

"The present structure of ISA is such that its contacts with the public, its stature as an organization, and its future development rests entirely upon its various committees. These committee members, by their contributions, have earned for themselves the gratitude of the entire Society.

EXECUTIVE COMMITTEE

"The Society is fortunate in having had an unusually active Executive Committee. Since the last Board of Directors meeting, five Executive Committee meetings have been held: An informal meeting, December 3, 1947, at Atlantic City; a two day session at New York, January 30 and 31, 1948; a session on April 23, in St. Louis; a two day meeting in Chicago, July 16 and 17, and fifth meeting on September 11, in Philadelphia. In addition to these physical meetings, voluminous correspondence attests to the business which has been conducted by mail.

"At its January meeting, the committee requested that the report of the Committee on Committees be published in the Journal in order to provide the membership with information on the scope and functions of each committee. The committee has also requested that its activities be given publicity by hav-

ing its actions appear in the Journal at the discretion of the Editor. It is felt that such publicity would help maintain an informed membership.

"The Executive Committee has reviewed its administrative organization and has adopted a method of handling Society work which results in a distribution of responsibility, and which relieves the President of considerable detail work. At the start of the year, the President assigned adminstrative supervision of twelve of the committees as follows:

C. F. Kayan — Education Committee, Constitution Committee, Research Committee.

H. H. Barnum — Employment Committee, Membership Committee, Sections Committee.

H. C. Frost — Coordinating Committee, Publications Committee, Rules and Procedure Committee.

F. H. Trapnell — Finance Committee, Meetings Committee, Recommended Practices Committee.

"Later in the year, H. C. Frost prepared a more complete proposal for administration of Society policy which was adopted by the Executive Committee as its operating guide.

"Special mention should be given to the assistance contributed to the Committee by A. F. Sperry. Although not a member of the committee, his experience in Society affairs and his interest in its welfare has made his participation extremely valuable. By special invitation, he has attended Committee meetings regularly even though he could not be given the privilege of membership on the Committee.

"During the year, a number of motions were passed to be placed before the Directors for action by them. These appear in chronological order in the following paragraphs, and action on them is given.

A. Article 1, Section 3, of the By-laws states:

'The grade of Associate Member shall be limited to those whose principal interest and occupation are not in the instrument field.

This limitation may be waived by a section. Permission to waive this limitation may be rescinded by the Board of Directors at any time after January 1, 1948.'

"It was the feeling of the committee that the purpose of the second paragraph of this section has been accomplished, and that permission to waive the limitation on the grade of Associate Member should now be rescinded. Accordingly, the following motion was presented:

Article 1, Section 3, of the By-Laws shall be amended to read as follows: "The grade of Associate Member shall be limited to those whose principal interest and occupation are not in the instrument field."

The motion carried.

B. Although it is not specifically stated in the Constitution and By-Laws, all members of the Executive Committee have been considered as members of the Board of Directors. It is felt that this is quite proper because of the necessary familiarity with Society operations which such members must have. In order to clarify this situation, the following motion was presented and carried:

The officers of the Society and other members of the Executive Committee shall be members of the Board of Directors; each with a voting power of one; which vote shall be in addition to the vote cast by the Director of the Section of which he is a member.

C. In an effort to secure legitimate income from whatever sources possible as well as to develop additional methods of stimulating membership growth, the following motion relative to the Employment Committee was adopted:

A charge to cover printing and other costs shall be levied on non-members and Associate Members of the Society for use of the Society Employment Service; the exact charge to be determined by the Employment Committee chairman but shall not exceed $10.00 for non-members and $5.00 for Associate Members.

This motion was tabled for further study.

D. During the year, the Exhibitors' Advisory Committee under the chairmanship of Warren F. Ha... conducted a survey to determine exhibit opinion as to whether exhibits sho... be continued on an annual basis as the past or whether they should ... held only in alternate years. Ball... were mailed to the 185 exhibitors pa... ticipating in one or more of the fi... three ISA shows. Replies were receiv... from 132. Of these, it was decided n... to count the votes of five United Stat... Government agencies who receiv... their space free of charge. The remai... ing 127 exhibitors who replied voted ... follows:

In favor of every two years.....
In favor of every year.....
No opinion—either plan acceptable....

In view of the decided expression ... opinion in favor of the two year pla... the Exhibitors' Advisory Committee re... ommended that the Society consid... most seriously holding no exhibit ... connection with its 1950 annual mee... ing and holding exhibits every tw... years starting in 1951.

The Executive Committee accepts t... report of the Exhibitors' Advisory Co... mittee and recommends to the Board ... Directors that exhibits be held only ... alternate years with the assumption th... the instrument manufacturers will n... support any instrument exhibits spo... sored during intermediate years by a... other organization.

This motion was tabled.

E. At the last Directors meeting, t... President was requested to appoint ... committee to study the factors involve... in setting up a permanent secretari... for the Society. Because of the im... portance of this question, the enti... Executive Committee served this pu... pose with Messrs. A. F. Sperry, H. ... Ferguson and C. O. Fairchild servin... as a sub-committee to handle the pre... liminary work. The question is an e... tremely complex one involving ever... Society activity. It became apparen... that a Permanent Secretariat cou... not be suddenly set up and begin t... function on a given date. At its Jul... meeting, the committee felt that th... best approach would be to hire ... suitable individual early in 1949 wh... would form the nucleus of a Permane... Secretariat, and who could organiz... the steps for its development. Accord... ingly, the following motion was pre... sented and carried:—

An addition shall be made to the budg... in the amount of $5,000.00 which wou... be Item 3—6 under Expense Appropri... tions entitled "Executive Salaries".

Following this, the report of the Pe... manent Secretariat Committee was a... cepted and the committee discharge... A new motion was made as follows:

A committee shall be appointed to mak... definite recommendations on the require... ments for a National Secretariat includ... ing (1) the handling of the business a... tivities of the Society, (2) the hiring ... the business manager, (3) the exhibi... The committee shall report at the fir... Executive Committee meeting followin... the annual meeting in September 194...

F. H. Trapnell was appointed chai... man of this committee.

F. Request was received from th... Philadelphia Section recommendin... F. A. Uehling for honorary member... ship. The following action was taken:

The Executive Committee recommend... to the Board of Directors that approva... of a petition from the Philadelphia Sec... tion recommending Mr. F. A. Uehling fo... honorary membership in the Instrumen... Society of America be given. This wa... presented with the necessary signature... in accordance with the requirements o... the Constitution.

G. For some time, certain deficiencies in Society structure have been noted

Committee in Charge of the 1948 Conference and Exhibit

Back Row: Clarence Wood, George Ehly, F. Trapnell, P. Putnam, J. Whiddett, J. Johnson, Jr., A. Adler, W. Gallagher.
Front Row: Stuart Rogers, Richard Rimbach, Lyman Allen, E. J. Grace, M. H. White.

Here is the team that made the 1948 Conference and Exhibit a success. The sincere thanks of all members of ISA goes to these men.

E. J. Grace was chairman of the Meetings Committee while Lyman H. Allen headed the Papers Committee of the Society.

ese have largely to do with con-uing technical activities and the nsorship of papers to be presented the membership and to the public. the January meeting, a committee s set up under the chairmanship of C. Frost to consider what changes ld be made in the committee struc-e of the Society to stimulate mem-ship activity in the various fields of trumentation and to smooth the way presentation of the results of such ticipation to the membership. As a ult of the excellent work of Frost, ed by the contributions of the entire mmittee, an outline of a Technical vision for the Instrument Society of erica was prepared and published the Journal for Aug. 1948. The ard of Directors on recommendation m the Executive Committee accepted s report.

In order adequately to prepare for iety meetings, they must be planned ll in advance. It was felt desirable t a Spring meeting in 1949 be held l that its authorization should come early as possible. Consequently, the llowing motion was made and pted:

Executive Committee recommends to Board of Directors that the Society d a Spring meeting in 1949.

The method of electing a President st several days before he is to take ice has worked to a disadvantage in t the incumbent does not know of election far enough in advance to plans for his administration. In an ort to correct this situation, the llowing motion by the Executive mmittee was adopted by the Board:

1. That the Directors belonging to ch Regional Area, as used by the ctions Committee, select one of their mber to serve as a member of the minating Committee, and a second mber to serve as an alternate.

2. That the member, or alternate, so ected be able to attend meetings of Nominating Committee to represent ir Areas.

3. That this Nominating Committee ect one candidate for each of the ctive offices covered by the Constitu-n and submit this slate of officers to Board of Directors no later than ay 1st of the current year with an nouncement to appear in the ISA urnal in the earliest practicable ue."

At this point President Exline asked ce-President Frost to read the re-ion of ISA Committee structure ich is as follows:

"Administration of all policy should under the direction of the Executive mmittee supplemented by a number working committees which should rry out specifically the duties assign-It has been shown in the past that it impossible for the president to as-me administrative supervision of all the commitees, and therefore, it is posed that this work be carried out three of the four Vice-Presidents. ch of these three Vice-Presidents uld head up a division of the Soci-y, and the remaining Vice-President uld be chosen to serve as first Vice-esident of the Society. In this capac-, he would be available for assign-nt to the administrative supervision all of the special or temporary com-ttees which might be required.

The proposed divisional setup would lude (1) the Membership Relations Division, (2) the Operating Division, and (3) the Technical Division. Based on present standing committees, it is proposed that they be divided as follows:

The Membership Relations Division would include the following committees: (1) the Advisory Council, (2) the Instrument Manufacturers Committee, (3) the Co-ordinating Committee, (4) the Employment Committee, (5) the Membership Committee, and (6) the Sections Committee. The Operating Division would include (1) the Constitution Committee, (2) the Finance Committee, (3) the Meetings Committee, (4) the Publications Committee, and (5) the Rules and Procedure Committee.

The committee organization under the Technical Division has been set up in an earlier communication and was published in the JOURNAL for Aug. 1948.

The Nominating Committee, because of the nature of its duties, should not be assigned to any of the above divisions but should instead report directly to the President.

The administrative organization outlined above would permit the President to assume overall supervision of the Society's activities, and it would be necessary only for him to follow all work which was being done through contact with the Vice-President, Secretary and Treasurer. One of the most important needs which it has not been possible to fill up to the present time is for the President to be sufficiently free from detail work to permit him to visit many of the sections during the year which he holds office so that the prestige of his office may be utilized to better advantage with members of the Society who have little normal contact with the executive group. Additionally, it will be possible for him to spend more time planning and promoting broad general policy and working toward the solution of major problems which confront the organization.

Under this arrangement, the Executive Secretary of the Society should serve primarily as the business manager, and as such, should not be a working member of any of the committees, but should be available at all times for consultation with committee chairmen or others actively promoting the Society's activities. Similarly, the Treasurer should not serve as a member of any of the working committees so that his efforts may be directed primarily toward the discharge of the duties to which he is assigned.

Since it is contemplated that the Executive Committee will administer all general policy and the Board of Directors will be concerned primarily with setting major policy based on recommendations from the Executive Committee, it will be necessary that the Vice-President in charge of the divisions be at all times fully acquainted with the work which is being carried out by the committees under their supervision. Accordingly, these Vice-Presidents would be responsible for bringing to each meeting of the Executive Committee reports on the activities of committees in their divisions and bringing to the attention of the Executive Committee problems with which their committees are confronted and recommend solutions.

Proposals to be made to the Board of Directors should have prior agreement of the Executive Committee members and should be presented to the Board by the Executive Committee, preferably by the President in a report which he would make at the meeting of the Board. This does not in any way indicate the likelihood that Directors should not be permitted to propose action by the Board from the floor, but it is assumed that in such cases if there is any question concerning conflict with present policy that such proposals would be assigned by the President to one of the Vice-Presidents for recommendations prior to further action by the Board."

SECRETARY'S REPORT

The demands on the time of the Secretary during recent months has been so great that it was not possible to prepare the Secretary's report in proper detail. This increase in work of the National Office is largely the result of a 42% increase in membership during the last 12 months, and a 40% increase in exhibit space.

With the increase in membership, the work of the Secretary's office has increased proportionally. Beginning with 1075, this increase is indicated in the following table:

August, 1946	1075
December, 1946	1650
April, 1947	2121
August, 1947	2296
March, 1948	2966
August, 1948	3275

THE SECTIONS

At the meeting in Chicago in September, 1947, the Society had 34 Sections. Since that time, the following Sections have been granted charters by the Executive Committee:

Richland Section, Charter No. 35, dated January 1, 1948. Rochester Section, Charter No. 36, dated February 16, 1948. Central Illinois Section, Charter No. 37, dated March 8, 1948. Houston Section, Charter No. 38, dated June 16, 1948. Montreal Section, Charter No. 39, dated June 16, 1948. Akron Section, Charter No. 40, dated July 19, 1948. Boston Section, Charter No. 41, dated July 28, 1948. Atlanta Section, Charter No. 42, dated August 23, 1948.

These charters were distributed at the Annual Banquet, September 15, 1948.

PUBLICATIONS ISSUED

Since the last report of Secretary, each member has received a three-post binder decorated with the ISA emblem, and the following:

1. Reprint of articles presented before "The Institution of Electrical Engineers" on the subject. "Automatic Regulators and Servo Mechanisms."
2. Reprint of a complete article before the same Society. "Automatic Control in the Chemical Industry."
3. Reprint from ASME, "Automatic Control Terms."
4. Reprint from ASME, "Piping Arrangements for Acceptable Flow-meter Accuracy."

THE EXHIBIT

Two hundred booths representing 22,022 square feet of actual exhibit space were laid out in the Arena of the Philadelphia Convention Hall by the Secretary as Exhibit Manager.

Of these, six were placed without charge at the disposal of the following:

American Institute of Physics	Booth 149
American Society of Mechanical Engineers	Booth 529
National Bureau of Standards	Booths 546, 548
Naval Ordnance Lab., Naval Gun Factory	Booth 245
New York Naval Shipyard	Booth 139

To promote attendance at the Exhibit:

110,000 stamps were printed and distributed.

Over 1,000 letters were written to executives inviting them to attend the exhibit and suggesting that their engineers and instrument men attend the Conference and Exhibit.

200,000 tentative programs were printed and distributed.

215,000 invitations have been printed and distributed as follows:

10,000 to members of the American Society of Mechanical Engineers.
10,000 to members of the American Institute of Physics.
10,000 to members of the American Institute of Electrical Engineers.
3,000 to ISA Members.
170,000 were sent to the Exhibitors for distribution.
Balance were sent to Philadelphia for registration at the Exhibit

The success of the ISA is more dependent on the membership and the local officers. The work of the National Office is unnecessarily increased by the local groups not answering National Office requests for information. For example, a Roster of Section Officers cannot be issued, as we still do not have this information on nine Sections. Two Sections have not advised the Secretary of the names of their members of the Board of Directors.

MEETINGS COMMITTEE

In the report of the Meetings Committee, recommendations for future meetings were as follows:

April 1949, Regional Meeting, Toronto Canada.
April 1950, Regional Meeting, Buffalo, N. Y.
September 1950, National Meeting, Buffalo, N. Y.
September 1951, National Meeting, Cleveland, Ohio.

The Meetings Committee which both cities selected for National meetings could handle exhibits so no change would be required if exhibits are run every other year.

CONSTITUTION COMMITTEE

Some three years of operation of ISA under the existing Constitution and By-Laws have brought out certain working difficulties which have been recognized as needing correction. Accordingly, the Constitution Committee consisting of Earl Rieger, Chairman, S. A. Gray, J. B. McMahon and P. T. Sprague, working throughout the year, has prepared a series of revisions. These were approved, with some modifications, by the Executive Committee at its meeting in Chicago on July 18.

In its work, the Constitution Committee has sought to correct errors, clear up ambiguities, and to make certain desirable additions. Changes thus proposed are given in detail separately. The Committee, furthermore, has studied the constitutions and by-laws of the various Sections with the view of making recommendations for the conduct of these groups through a set of rules. Additional activity of the Committee has consisted in suggesting possible changes in Society operation, and since these changes involve policy, they are being studied by various agencies within the Society to evolve final recommendations.

Since the issue of a new Constitution and By-Laws involves heavy expense, the final release of the new documents is to be postponed until the further details of revision are worked out during the coming year.

Proposed Changes in the Constitution and By-Laws

IN THE CONSTITUTION:

Article IV—Section 3, Omit this Section as it is contained properly in the By-Laws.

Article VI—Section 3. Omit the words, "and By-Laws."

Article VI—Section 4. Change to read, "All Members shall be entitled to one vote on all questions coming before the Society. No other membership class shall have a vote."

Article VII—Section 1. Delete word "First" in First Vice President. Following list of officers, change to read, "Two each of the Vice Presidents shall be elected on alternate years. The Executive Committee shall designate one of the four Vice Presidents as First Vice President."

Article VIII—Section 2. Add, "The new officers shall take office following the Annual Banquet."

Article VIII—Section 3. Only Members shall be eligible for election as officers.

Article VIII—Section 5. Add to end of sentence, "at which time they shall elect the officer to fill the unexpired term."

Article IX—Section 2. Change to read, "Officers and other members of the Executive Committee shall be members of the Board of Directors, each with a voting power of one. Each vote shall be in addition to the vote cast by the Director of the Section of which he is a member."

Article IX—Section 4. Change, "Majority of its voting members," to, "Majority of its members."

Article X—Add Section 5 to read, "The Annual Meeting of the Board of Directors shall be set as during or just preceding the week of the Annual Meeting of the Society. Special meetings to be called by the President, or at the direction of the Executive Committee, or by petition of one-quarter of the total number of Directors. Written notice of such special meetings shall be sent out at least 30 days before the meeting dates. Only such matters as are covered in the agenda accompanying the notice of a special meeting shall be considered at such meeting."

Article X—Section 2. Remove the Section and put in a new Article XI. Under heading "Amendment of By-Laws" add Article XI.

Article XI—Section 1. To read, "Amendment of the By-Laws may be made by a two-thirds vote of the Board of Directors present at a meeting where a 30-day notice of the proposed amendment has been sent to them."

Article XI—Section 2. To read, "The Board of Directors shall amend the By-Laws so that they are in harmony with any amendment to the Constitution."

IN THE BY-LAWS:

Article I—Section 3. Remove last paragraph of this Section reading, "This limitation may be waived by a Section. Permission to waive this limitation may be rescinded by the Board of Directors at any time after January 1, 1948."

Article V—Section 5. Change words, "Board of Directors" to "Executive Committee."

Article VII. Number this Article VIII, Article VIII to IX, IX to X, X to XI, and XI to XII. Add in ne Article VII to be headed "Method Nominating Officers," and to re "A Nominating Committee shall co sist of eight Directors, one from ea of the eight Regional Division selected by the Membership Repr sentative in those areas. They sha name a slate of officers containin preferably one name for each offic this slate to be announced to the D rectors and published in the first ne issue of the ISA Journal."

Article VIII (New IX) Section Change to read, "The following sha be the Standing Committees of th Society and their chairmen shall b appointed each year by the Presiden with the approval of the Executiv Committee."

Article VIII—Section 2b. Delete wo "Advisory."

Article VIII (New IX) Section Change to read, "The duties of the Committees shall be defined by th Rules and Procedures Committe with the approval of the Executiv Committee and the Board of Directors

Article X (New XI). Add Section 4 t read "Remission of Charter from Section may be made by the Board o Directors by a two-thirds vote of tho present at a meeting of which the have been notified in writing at lea 30 days before the meeting."

EMPLOYMENT COMMITTEE

THE EMPLOYMENT SERVICE

Registered Applicants for Positions

CLASS A — Graduates of Technical Institutions	78
CLASS B — Instrument Technicians and Mechanics	12
CLASS C — Students	6
CLASS D — Miscellaneous Applicants	11
	21

Open Positions:

Open positions announced in the Journal of the ISA	83
Open positions referred to the Employment Committee but not announced	16
	99

For the first year of the operation the Employment Service, 53 open pos tions announced; for the above secon year, 99 open positions announced.

Known positions filled through th Employment Service for the year 194 1948—23.

Total applications received and fo warded to prospective employers f open positions listed, and not liste during the year 1947-1948—411.

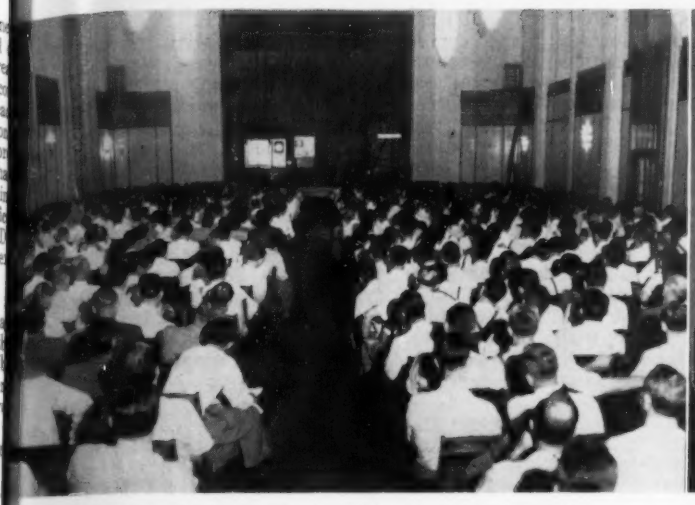
Consideration has been given to i stituting a charge for employme service, and the following facts esta lished.

The total positions listed may be d vided as follows:

1. Manufacturers who offered to pay f listing 12
2. Listing solicited by Employment Co mittee on a "no charge" basis in order present opportunities to the members..25
3. Listings submitted by members companies employing, with no offer to p 63

Conclusion based on these figure was that to effect a charge to man facturers would result in an appr ciable loss in listings, and a consequen loss of opportunities to the member A member applicant may not be asse sed a charge, as the Employment Ser ice is a part of the member's dues.

Non-Member applicants, of whic there were 135 of the total of 21 should be assessed in some manne Decision made to restrict the Employ ment Service to members only. No



"Automatic Control Principles" by Aiken and Kowalski Again Attract the Largest Crowd of the Week.

Historical Exhibit on the Stage of Convention Hall.

mbers making application will be vised of this decision and invited to n the Society which will automatily result in the availability of the mployment Service.

ECOMMENDED PRACTICES COMITTEE:

This Committee held an interim eting in St. Louis on April 23 with irteen of its nineteen members pres-t. Hampered somewhat by summer hedules and vacations the various acvities of the Recommended Practices ommittee are making general proress. As to membership, the following anges have been made: R. D. Webb s resigned due to press of other uties; P. R. Hoyt of Shell Developent Company, San Francisco, Calornia, has accepted appointment; H. U. Fisher of Monsanto Chemical ompany, Columbus, Ohio, has been ppointed and his acceptance is expecd at an early date. Both new mems have been requested to start submmittees in their respective areas.

The Procedures Subcommittee estabhed at the St. Louis interim meeting s completed its Tentative Style Manal including a format to be used in e publication of approved Recomended Practices. The standard cover eet, foreword and committee listings ill be used in publishing the two tenative practices approved at the inrim meeting. These two items, name-; "Coding of Thermocouple Wire and ad Wire" submitted by RP-1; and "Manometer Tables" submitted by RP-. have been turned over to the Pubcations Committee and should be in rint soon.

The list of existing subcommittees, all which are now active in various ases of the projects assigned, toether with their chairmen, is as llows:

P-1 — Thermocouple and Extension Wire andards, Chairman, H. M. McCarthy. (Inal work completed; committee meeting at iladelphia to outline further steps.)
P-2 — Manometer Tables, Chairman, W. Brombacher. (Work completed)
P-3 — Flowmeter Installation Practices, airman, R. L. Galley.
P-4 — Control Valve and By-Pass Instalions, Chairman, W. H. Fortney.
P-5 — Flow Plan Symbols, Chairman, avid E. Hostedler.
P-6 — Recommended Practices for Pneuatic Transmission and Controller Usage, airman, H. F. Moore.
P-7 — Pneumatic Control Circuit Pressure sts, Chairman, S. C. Chapman (Aruba ction).
RP-8 — Outside Instrument Protective Cabinets, Chairman, W. A. Crawford.
RP-9 — Instrument Tubing Supports, Chairman, J. Johnston, Jr.

J. E. White has been appointed liaison delegate to the joint ASME-API Volumetric Committee, and has assumed his duties in the formulation of a code for positive displacement meters.

Several additional items have been added to the list of 17 future projects compiled at the St. Louis meeting. It is planned to circulate this list to all RPC members who are not now acting as subcommittee chairmen and ask for volunteers to head up projects in their areas. Information from foreign sources to the Executive Offices has been passed on to the interested parties in the RPC. This material includes: (1) recommendations in standardizing face-to-face dimensions of control valves, passed on to RP-4, members of NSSC and SAMA 20 a paper on Flow Plan Symbols, passed on to RP-5; a brochure on terminology, passed on to IIRD Terminology Committee chairman. It is thought these data will prepare the recipients for the liaison meeting with foreign delegates tentatively scheduled for September 15.

SECTIONS AND MEMBERSHIP COMMITTEES

Since the duties of the Sections and Membership Committees overlap in many respects, it has been found advisable as a practical matter to use the same personnel on both Committees. Also as a practical matter, it has been found advisable to assign a certain number of sections to each committee member for his active supervision. The list of committee members, and the names of the Sections assigned to each, are shown on the attached lists.

Since the last meeting of the Board of Directors, the Society has increased considerably, both in number of Sections and membership. A memorandum on "Suggestions on Organizing a Local Section of the Instrument Society of America" has been prepared and is available for use by any group interested in or contemplating the organization of a new local section. This also contains suggestions for operating a newly-formed section. The Committee proposes, during the coming year, to expand this material into a Manual for Operating a Local Section.

At its meeting in Chicago on July 16th and 17th, the Executive Committee assigned to the Sections and Membership Committees various problems to study. Among these are the questions of the benefits to be granted each of the various classes of membership; the question of foreign memberships; assistance to local sections in preparing programs; steps to be taken by the National Society in the event of mismanagement of a local section; and the formation of sub-sections, particularly student sub-sections. These will be discussed by the Committees at a meeting to be held during the week of the Annual Convention, and will be reported on to the Executive Committee during the coming year.

The Committee still feels that the problem of maintaining interest in local sections is the most pressing problem confronting the Society, and hopes during the coming year to work out effective means of furnishing help to local sections in solving this problem. An analysis of membership figures shows that a high percentage of the increase in membership figures shows that a high percentage of the increase in membership is the result of chartering new sections, rather than an increase in number of members in existing Sections. We feel that this situation is not healthy, and that the main growth of the Society in the future should come from increased membership in existing Sections. Therefore, the matter of maintaining membership interest in the local section activities is, in our opinion, paramount.

EDUCATION COMMITTEE

There has been no meeting of the Committee as a whole. However, in March there was held an organization meeting at which M. B. Hall, L. F. Parachini, Richard Rimbach and Dr. E. D. Wilson were present. At this time, certain fundamentals as to the Committee's activities were discussed, and following principles laid down:

(1) The substance of a previous report of the Sub-Committee on Industrial Instruments was reaffirmed and is quoted as follows:

"The development of an Industrial Instrument Education Program is a real problem and it was agreed that it might be considered in three phases: At the Instrument Mechanic Level; At

the Undergraduate Level in Engineering Schools; At the Graduate Level.

The first phase is covered at present by instrument company training courses, specialized short courses in educational institutions and within industry courses. The scope of these courses varies widely, and the published material available for study is incomplete and limited. It is believed that there is a definite need for a standard text covering this phase of an educational program and it is logical that ISA should sponsor such a project.

The work involved in the preparation of this material within a reasonable period of time is beyond the capacity of one or a group of individuals on a part-time basis. It has been suggested that it be made a full time project by the selection of one who is well qualified to correlate and prepare this material under the direction of an educational board which should be representative of the subjects involved. Ways and means for carrying out these ideas must be developed within the Education Committee and presented to the Board of Directors for consideration.

In the second phase of the program it has been suggested that those educational institutions which are conducting courses in instrument education send to the Educational Committee a description of their courses including the department in which the course is to be set up, the total course hours divided into lecture and laboratory time, the course outline and laboratory manual, description of equipment used and other data pertinent thereto. This material could be correlated without necessarily identifying the source and made available to any engineering school that might be interested.

As these courses develop in engineering schools it might be desirable to set up a program for Summer course instruction for college instructors in order to make available to these instructors the practical aspects of industrial instrument education.

The graduate level phase of this program will be involved primarily with the theory of Automatic Control, and it has been suggested that the present activities of the Industrial Instrument and Regulators Division of ASME be considered the source of information in this field." It was felt that the above represented an outline of a program for the Sub-committee on Industrial Instruments, which should serve as a guide to their activities.

(2) It was recognized that there are certain overlapping interests of the various sub-committees and parts of the outline above for the program of the Industrial Instrument Sub-Committee may well apply to the work of other Sub-Committees.

(3) The Sub-Committees should make a survey on instrument education in their fields to determine what is available at present. This survey is to include all types of schools, from trade schools through colleges and post-graduate work. It will undoubtedly take a considerable portion of the coming year to make this survey complete.

(4) At the request of the Sub-Committee on Industrial Instruments, Worcester Polytechnic Institute agreed to offer a three weeks course to college instructors in June 1948. Notices were sent to some 80 colleges but it turned out that there was not sufficient interest nor enough registrants to warrant giving the course.

(5) It was decided that the Committee would not sponsor or approve any pure correspondence courses on instruments which did not make suitable provision for laboratory work. A number of correspondence schools have been showing interest in offering a correspondence course on Industrial Instruments, but none of them as yet have succeeded in working out any arrangement whereby a student could have access to actual instruments for experimental work. The Committee feels that actual experience with instruments, which must involve laboratory work, is essential to any successful instrument course.

The Committee hopes to promote and encourage activities in the following fields:

(1) Courses for instrument repair men sponsored by instrument manufacturers.

Do you mean to say the ISA Convention lasted 3 WEEKS??

(2) Trade school courses on instrument repair and maintenance somewhat similar in nature to those offered by the instrument manufacturers.

(3) College courses at the undergraduate level on industrial instruments. These courses should be designed to train men in the knowledge of instrument operation, precision and speed of response; they should not be pointed toward the design of instruments, or the repair and maintenance of instruments, but rather toward their application in industry.

(4) College courses at the post-graduate level which may include more of the same objectives as the undergraduate work but may also in addition deal with the theory of process control.

The Sub-Committee on Industrial Instruments has not held a formal meeting but there has been considerable correspondence conducted by the Chairman, M. B. Hall, and the information already given covers adequately the activities of this Sub-Committee.

The Sub-Committee on Electrical Instruments has not held a meeting but its Chairman, L. F. Parachini, has been in contact with his members and they are planning definite activities during the coming year.

The Sub-Committee on Optical Instruments headed by Dr. A. E. Parr has just been organized and we are looking forward to some accomplishments by them this coming year.

While it is felt that it is not the function of the Committee on Education to operate schools itself, nevertheless, the Sub-Committee on Industrial Instruments and the Sub-Committee on Electrical Instruments are to operate refresher schools during the September meeting of the Society in Philadelphia.

SUB-COMMITTEE ON INSPECTION AND GAGING

This Committee has been dormant since the close of the First National Conference in September 1946. In May 1948 the present Sub-Committee was selected and is now organizing to study how best it can serve the needs of the country. Its initial endeavors will necessarily be exploratory, as indicated later in this report.

It is our earnest hope that this area of industrial activity may be thoroughly examined as to its problems and needs for trained personnel. We will be most grateful for suggestions as to possible activity this Committee might initiate and/or expand. The following outline is our proposal for the committee season's work:

A. Definition of the fields of activity included in Inspection & Gaging.
   1. Types of Inspection Operations.
   2. Types of Inspection Apparatus.
   3. Technical data on apparatus applications.

B. Classification of Industrial Positions requiring Inspection & Gaging experience.

C. List of Training Programs and Courses of Instruction on Inspection and Gaging.
   1. Vocational and Trade Schools.
   2. Technical Institutes.
   3. Colleges.
   4. On the Job Training.
   5. Industrial Apprenticeships.

Lists of Formal Course Outlines.
Lists of Reference Textbooks.
Lists of Technical Manuals (ASA Standards, ASTM Standards, Etc.)
Lists of Visual Aids.
Lists of all chapter Committee's programs.
Lists of available speakers from Industry & Education.
Lists of Technical Papers.
Lists of programs of other technical societies in closely related fields (ASQE, ASME, ASTE, Etc.)

These lists will be acquired by inquiry to all schools and industrial concerns who indicate interest in such an effort.

At the moment the Committee is canvassing the 28 Ordnance subsidized College Laboratories in this country to determine their condition of activity and their needs.

It is proposed to compile a 3 x 5 card system similar to a library file for most of the information. These cards would be duplicated and sent to the interested areas. As a trial, this scheme can be supported by the facilities available in the Sub-Committee Chairman's office. It is not our intention to build up an expensive service that will become a burden to the Society.

FINANCE COMMITTEE

In addition to acceptance of the following report, the Board approved a motion that an addition be made to the Budget in the amount of $5,000.00 to cover salary and expenses for a Business Manager who would not be added to the payroll until sometime after the first quarter of 1949. This money would be taken from 1949 income.

The Board further approved a motion to add $7,500.00 to 1949 Exhibit income if possible in the opinion of the Meetings Committee to absorb the additional expense items indicated above.

Instrumentation Courses

Two courses in instrumentation have come to our attention and are passed on here both as a matter of news and for the help they may be to other groups thinking about doing similar work. One course is sponsored jointly by the Newark College of Engineering and the New Jersey Section of ISA. This course starts Sept. 30th and continues for 15 weeks with each weekly meeting 2½ hours. Fee for the course is $25.00. Its contents are as follows:

I. *Introduction:* Energy; temperature scale; heat transfer; pressure; physical properties of gases, liquids and solids.

II. *Temperature Measurements:* Mercury in glass thermometers, mercury or gas-filled thermometers, vapor tension thermometers, bimetallic thermostats, thermoelectric thermometry, resistance thermometry.

III. *Pressure Measurements:* Absolute and differential pressure measurements, low pressure instruments, medium pressure instruments, high pressure instruments.

IV. *Flow Measurement:* Orifice, venturi, flow nozzle, area type meters.

V. *Liquid Level Measurement:* Direct, indirect, elementary discussion of electrolytic and photoelectric applications.

VI. *Composition and Quality:* Humidity, pH, density.

1949 ESTIMATED EARNINGS AND BUDGET

Estimated Income

I. INCOME FROM CONFERENCE AND EXHIBIT:			
(a) Booth Rental 15,000 ft. at $3.00	$45,000.00		
(b) Sale of Preprints	2,500.00		
(c) Non-Member Registration (net)	4,200.00		
		$51,700.00	
II. INCOME FROM MEMBERS:			
(a) Present Regular Members	$11,710.00		
(b) Present Associate Members	1,400.00		
(c) Present Student Members	60.00		
(d) New Members (All Classes)	4,400.00		
		$17,570.00	
III. INCOME FROM MISCELLANEOUS SOURCES:			
(a) Sale of Insignia	$2,000.00		
(b) Sale of Other ISA Material	500.00		
		$ 2,500.00	
TOTAL ESTIMATED GROSS INCOME			$71,770.00
LESS EXPENSE APPROPRIATIONS AS DETAILED			63,760.00
APPROXIMATE NET INCOME 1949			$ 8,010.00

Expense Appropriations

I. OPERATING EXPENSES (Exclusive of Conference & Exhibit)			
(a) Committee Appropriations:			
1. Recommended Practices	$ 250.00		
2. Sections	100.00		
3. Employment	1,000.00		
4. Miscellaneous	500.00		
		$ 1,850.00	
(b) Appropriations for Officers:			
1. President	$ 300.00		
2. Treasurer	200.00		
3. Secretariat:			
(3.1) Salary	$3,000.00		
(3.2) Expenses (½)	2,500.00		
(3.3) Asst. Sec'y. Sal.	1,000.00		
(3.4) Non-Exec. Salary	3,900.00		
(3.5) Office Expenses	3,000.00		
	$13,400.00		
		$13,900.00	
(c) Other Operating Appropriations:			
1. ISA Journal Editor	$ 200.00		
2. Legal (½) (total)	200.00		
3. Audit	250.00		
4. Miscellaneous	600.00		
		$ 1,250.00	
			$17,000.00
II. PUBLICATION EXPENSE (Exclusive of Conference & Exhibit):			
(a) ISA Journal	$ 6,000.00		
(b) Rec. Pract. Com. Reports	3,000.00		
(c) Miscellaneous	2,000.00		
			$11,000.00
III. PROPERTY APPROPRIATIONS:—			
(a) Office Equipment	$ 500.00		
(b) Meetings Equipment	200.00		
			$ 700.00
IV. SELF-LIQUIDATING EXPENSES:—			
(a) Insignia & Other Items for Resale			$ 2,000.00
V. CONFERENCE APPROPRIATIONS:—			
(a) Speakers	$ 1,000.00		
(b) Badges & Registration (½)	650.00		
(c) Signs (½ total)	100.00		
(d) Meeting Transcriptions	750.00		
(e) Projectors (Rental & Operation)	500.00		
(f) Program Printing	1,000.00		
(g) Public Relations	3,000.00		
(h) Expenses for Con. Supv. (½)	110.00		
(i) Special Clerical help (½)	200.00		
(j) Clerical Assts. hotel & travel (½ total)	220.00		
(k) Registration Booths	500.00		
(l) Hotel Meeting Rooms (incl. Regional)	300.00		
(m) Preprints of Papers	2,000.00		
(n) Miscellaneous	500.00		
			$10,830.00
VI. EXHIBIT APPROPRIATIONS:—			
(a) Management Salaries & Expenses:			
1. Exhibit Managers Expense (½)	$ 2,500.00		
2. Exhibit Managers Asst. Salary	400.00		
3. Exhibit Managers Cleric. Salary	300.00		
4. Exhibit Managers Asst. Expense	110.00		
5. Special Clerical Help	200.00		
6. Clerical Assts. Expenses	220.00		
7. National Office Expenses	1,000.00		
		$ 5,730.00	
(b) Pre-Show Expenses:			
1. Badges & Registration (½)	$ 650.00		
2. Space Contract Printing	700.00		
3. Advertising Brochure	3,000.00		
4. 1948 Show Questionnaire	1,500.00		
5. Exhibit Bulletins	1,500.00		
		$ 7,350.00	
(c) General Show Expenses:			
1. Contractors Fee	$ 3,000.00		
2. Guards	500.00		
3. Signs	100.00		
4. 1950 Show Booth	500.00		
5. Special Exhibit	2,000.00		
6. Attendance Rating	250.00		
7. Insurance	1,100.00		
8. Registration Listings	500.00		
9. Legal Expense (½ total)	200.00		
		$ 8,150.00	
(d) Miscellaneous		1,000.00	
			$22,230.00
TOTAL EXPENSE APPROPRIATIONS			$63,760.00

The Philadelphia Section of ISA and the Pennsylvania State College Center in Swarthmore, Penna. are sponsoring three evening courses. Classes begin September 20, 1948 and cover the following:

COURSE A—Temperature and Electrical Measurements (Physics X921) 96 hours — Fee $45.00. Course includes basic theory of temperature and expansion of gases, liquids and solids; also indicating and recording thermometers of the glass stem type, bimetallic type and pressure actuated type; and electrical methods of temperature measurement.

COURSE B—Pressure, Flow and Liquid Level (Physics S920) 80 hours —Fee $37.50 (for students having completed Physics X921). Course includes theory of pressure, flow and liquid level measurements plus a description of indicating and recording pressure gages, flowmeters and liquid level instruments.

Prerequisites: High School graduation or Industrial Equivalent.

COURSE C — Advanced instrumentation, Automatic Controls (Physics X922) 96 hours. Fee: $45.00. Course includes a review of the instruments used in measuring control variables; also presents fundamental theory and type of automatic control, mechanisms of control, and applications of control systems.

Prerequisites: Physics X921 and Physics 920 or High School graduation with a course in Alegbra and Physics, plus Industrial Experience in Instrumentation. The College approved instructors for these courses are members of the Philadelphia Section of the ISA and in addition to their engineering qualifications are also active in industrial instrumentation work.

The Calendar

A new calendar appears this month which I hope will be more useful when it is complete. The postal cards for reporting meetings in advance have not worked well for me. Last month I received cards covering September meetings with one exception. This month they cover October meetings and there is no use putting them in the October issue.

It is my hope that the calendar of Secretaries with their addresses, telephone numbers, and the meeting data will do all that the old calendar did. Travelers can telephone to determine the place and subject of the meeting, if they are in any particular city on the meeting night.

Please check the data for your section and fill in the blanks for me. Please don't forget the telephone number.

Section News

There seems to be some confusion as what is required in a section news re In general, it should contain a resume of last meeting, who spoke and the subj Also, any section business transacted at meeting that is of national interest sho be included. Other business that is pur local need not be included.

News reports should be sent in right af the meeting. Don't wait until the next me ing because you will sometimes miss issue of the Journal. They must be in editor's hands not later than the 25th each month to make the next issue.

ARUBA

Our regular monthly meeting was h Tuesday, September 7, 1948, with twen one members present.

Mr. E. S. Stanley, Chairman of the nom nating committee, presented a slate of ca didates from which we will select our o cers for the coming year. Voting will ta place at our October meeting. Mr. M. Holly, substituting as chairman of the RP reported that answers to the questionna sent out on RP-7 "Pneumatic Control C cuit Pressure Tests" are beginning to co in and agree in general with our recomme dation.

It was reported by Mr. M. W. Morris f the Program Committee, that our electron course is being held up pending some da on cost of materials considered necessary performing the experiments to accompa the instructions.

SECTION SECRETARIES AND MEETING DATA

	Telephone	*Date*	*Dinner*	*Meeting*
Akron: Fred Appel, 932 Columbia Ct., Barberton, Ohio.				
Aruba: M. R. Holly, P. O. Box 389, c/o Lago Oil & Transport Co., Ltd., Aruba, N.W.I.		1 Tues.	X	7:00
Atlanta: Emory W. Clark, P. O. 819, Atlanta, Ga.				
Baltimore: Felix Cox, Bethlehem Steel Co., Sparrows Point, Md.		2 Fri.		
Boston: C. J. Nazzaro, 456 Central Avenue, Milton 87, Mass.				
California: D. D. Taylor, 234 E. Colorado, Pasadena 1, Calif.		1 Tues.	6:45	
Central Illinois: T. A. Carroll, 721 Hurlburt St., Peoria, Ill.				
Central Indiana: M. Underwood, 1235 W. 33rd St., Indianapolis, Ind.		1 Tues.	X	7:30
Charleston: W. E. Warner, Rt. #3, Box 274, Charleston, W. Va.		1 Mon.	X	8:00
Chicago: Floyd E. Erstman, 506 S. Wabash Avenue, Rm. 611, Chicago 5,Ill.		1 Mon.	6:30	8:00
Cincinnati: Smith Hickenlooper, 1147 Beverly Hills Dr., Cleveland, Ohio.		4 Mon.		
Cleveland: L. W. Waldrip, 3030 Euclid Ave., Cleveland, Ohio.		4 Wed.	6:30	8:00
Cumberland: Clyde Babst, P. O. Box 447, Cumberland, Md.		*Tues. after 4 Mon.*	6:30	8:00
Detroit: T. S. Cawthorne, 570 Maccabees Bldg., Detroit 2, Mich.		3 Tues.		
Eastern New York: Wm. J. Claffie, Winthrop Chemical Co., 33 Riverside Ave., Rensselaer, N. Y.		1 Tues.	6:30	
Gulf Coast: A. E. Bunn, 2237 North Street, Beaumont, Texas.		3 Tues.		
Houston: E. E. Kleir, #12 Sterling Bldg., Houston 2, Texas.		Last Mon.	X	8:00
Kansas City: W. J. Blackburn, 1621 E. 31st St., Kansas City, Mo.		Last Tues.	6:30	7:30
Louisville: Paul B. Smith, 3016 Beaumont Road, Louisville, Ky.		Last Tues.	X	8:00
Montreal: F. S. McCarthy, Canadian Industries, Ltd., Box 10, Montreal, Quebec, Canada.				
New Jersey: W. D. Archibald, 605 Westminster Ave., Elizabeth 3, N. J.		1 Tues.	6:00	
New Orleans: W. H. Haney, 2927 Music Avenue, New Orleans, La.		*No Regular Date*		8:00
New York: C. E. Haggerty, 7552 181st St., Flushing, L. I., N. Y.		Last Mon.	6:30	8:00
Niagara Frontier: K. J. Fees, 669 Ashland Avenue, Niagara Falls, N. Y.		4 Mon.	X	8:00
Northern Indiana: C. P. Haynes, 935 177th Place, Hammond, Indiana.		3 Wed.	6:30	7:30
Oak Ridge: J. O. Alexander, 101 Hoyt Lane, Oak Ridge, Tenn.		1 Wed.	7:00	
Ontario: A. J. Legault, Bristol Co. of Canada, Ltd., Toronto, Ontario, Canada.		3 Thur.	6:45	
Philadelphia: C. W. Wood, 6908 Market St., Upper Darby, Pa.		3 Wed.	X	
Pittsburgh: L. M. Susany, c/o Carnegie Institute, 4400 Forbes St., Pittsburgh 13, Pa.		4 Mon.	6:30	8:00
Presque Isle: R. P. Marshall, 161 W. Main St., North East, Penna.		4 Tues.	X	8:00
Richland: B. E. Woodward, General Electric Co., Hanford Wks., Richland, Washington.		2 Wed.	X	7:30
Rochester: R. C. Swartz, Jr., 1201 Granite Bldg., Rochester 4, New York.		3 Tues.	X	8:00
St. Louis: W. G. Lee, 4710 Delor St., St. Louis 16, Mo.		1 Tues.	6:30	8:00
Sarnia: C. G. Elder, 314 Maria St., Sarnia, Ont., Canada.		2 Fri.	X	
South Bend: Charles E. Williams, 921 Lawndale Avenue, South Bend, Ind.		1 Thur.	6:30	7:30
South Michigan: Homer Kuiper, 828 Davis St., Kalamazoo, Mich.		2 Wed.	6:30	8:00
South Texas: H. C. Givens, La Gloria Corp., P. O. Box 637 Falfurrias, Texas.		1 Tues.	X	7:30
Tennessee: L. W. Thayer, 1229 Bristol Highway, Kingsport, Tenn.		*No Definite Night*	7:00	8:00
Tulsa: C. R. Horton, 510 S. Lansing, Tulsa, Oklahoma.		1 Mon.	X	7:30
Twin Cities: Ray Hooper, International Div. Minneapolis-Honeywell Reg. Co., 2753 Fourth Ave , Minneapolis 8, Minn.		4 Tues.	6:30	
Washington: G. M. Rolls, c/o American Instrument Co., 8010-20 Georgia Avenue, Silver Spring, Md.		3 Mon.	X	7:30
Wayne County: R. L. Swenson, 2141 Oak St., Wyandotte, Michigan.		3 Mon.	6:30	8:00

At the conclusion we enjoy two sound movies titled "Oil From the Earth" and "Flight Log" which were secured from the Shell Oil Company. The first film consisted of a brief resume of the history of oil, its refinement and its uses. The second film emphasized that petroleum research, as carried out by the oil companies, has improved the quality and power of airplane fuels which has resulted in decreasing the size of the dead load (engine, fuel, etc.) as compared to the pay load (passengers and cargo).

Our next meeting will be held on October 4, 1948 at which time our election of officers for next year will take place.

—M. H. HOLLY, *Sec'y*

HOUSTON

Regular meetings are held the last Monday of each month at the Houston Engineers Club at 8:00 p. m. Program material and changes in the meeting dates are announced in the *Slide Rule*, the Houston Engineers Club monthly publication.

The programs have generally been designed to interest instrument engineers in the petroleum, chemical, and allied industries, whether on the customer or vendor side of the fence. This may seem like a rather narrow field to cover under the name of "Instruments" but it was decided when the section was formed that a well defined coverage would make a more stable organization in which each member could find practically all meetings of interest. Results have borne this out. Each meeting is attended by 60 to 70% of the membership.

The last meeting was the summer social and took the form of a stag excursion and dinner. About seventy-five members and guests thoroughly enjoyed the ride from the Houston Turning Basin, down the Ship Channel in a converted sub chaser belonging to Parker Brothers and Company. The vessel docked next to the enshrined Battleship Texas and all hands went ashore for dinner at San Jacinto Inn.

Persons interested in attending meetings as visitors, to look us over, are welcome. Prospective members are invited and they may contact the Secretary, E. E. Kleir, at the Foxboro office in Houston, or practically any instrument "peddler" in the area

—J. A. PARKER, *Corr.*

(This is the first report from the new Houston Section. A hearty welcome to you.—ED.)

NEW JERSEY

On Wednesday, November 10, the Oxford Room of the Essex House in Newark, New Jersey will be the scene of the first social event given by the New Jersey Section.

An informal dinner dance will start with a reception at 7:00 p. m. with cocktails available at the bar adjoining the dining room. Dinner will be served at 7:30 p. m. and Marty Arnes and his Essex House orchestra will play for dancing during dinner and until midnight.

Members and their friends who do not wish to miss a very entertaining evening are urged to contact Bill Archibald of Energy Control Company, Committee Chairman, or Harold McCarthy of Standard Oil Development Company and George Feely of Trinity Equipment Company, not later than October 27th. —W. A. HAGERBAUMER, *Corr.*

NORTHERN INDIANA

ISA activities for '48-49 are about to start up again, and to start things off, I'd like to send in a report from the Northern Indiana Section. Our officers for this year will be the same as we had last year. At a meeting in the late spring, it was decided that since they had served well and since a change was not particularly feasible, it would be wisest not to make any change. Never-the-less, an election was duly held and the officers re-elected.

Our Plant Trips Chairman, Mr. Bob Parr has arranged for a trip through the Hays Company Plant at Michigan City, Indiana on September 25. As many of the members as can will make the trip over there and we'll combine the trip with a picnic to be held in that city.

At an Executive meeting, it was decided that while the weather permits, the members will get more out of these trips than they would out of regular meetings, so another trip is planned for October, but the details have not been ironed out at the time of writing. We plan our first regular formal meeting for November.

—J. BAUM BECKMAN, *Corr.*

TENNESSEE

Guest speaker for the first fall meeting, Sept. 8th, Mr. W. H. Howe of the Foxboro Company, gave a most interesting and educational talk on the varied types of temperature measuring systems employed in industrial instruments. After a brief explanation of the workings of each system, a comparison was made between the systems giving the advantages and disadvantages of each. The talk was well illustrated with slides showing the basic temperature measuring systems, how they are compensated for ambient temperature changes, and going on into the more complicated circuits of the potentiometer and resistance thermometer.

Prior to the meeting the speaker was entertained at dinner by a group of the members, and the meeting was called to order at 7:15 p. m. with the President, Mr. Robert Parris, presiding. Present at the meeting were thirty-five members and ten guests. Business transacted at this meeting included appointment of Mr. George Moorehouse as Historian and Mr. W. H. Shelburne as temporary National Delegate to act for the delegate, Mr. J. T. Elder, who was unable to attend the meeting. One new member was introduced to the Section, Mr. William G. Baker, Jr., who recently transferred from the Wayne County Section. Following the Treasurer's report the speaker was introduced by Mr. Parris, and the meeting adjourned at 10:00 p. m.—J. T. ELDER, *Corr.*

WAYNE COUNTY

At our first meeting for this season we spent considerable time discussing happenings during the summer, giving reports on the Convention, and discussing educational programs.

Mr. Cushing showed the sound film "Adventures in Research," prepared by the Westinghouse Company. This touches upon radar, radio, therapy, X-Ray and television.

—J. MACPHERSON, *Corr.*

I. S. A. EMPLOYMENT SERVICE

Forward your letter to INSTRUMENT SOCIETY OF AMERICA, 1117 Wolfendale St., Pittsburgh 12, Pa.

FLIGHT TEST INSTRUMENTATION ENGINEERS (Development). One—P4 Mechanical; One—P3 Mechanical; One—P2 Electrical; One—SP8 Electrical; One—SP8 Mechanical. All for Naval Air Test Center, Maryland. Box 169.

MECHANICAL ENGINEERS (TWO) Instrument Development. M. E. Degree plus one year practical experience in fields of steam power plants, design testing or operation. For development of instruments for testing high pressure-temperature marine steam power plants and main propulsion machinery. Location U. S. Naval Boiler and Turbine Laboratory, Philadelphia, Pa. Box 170

MECHANICAL, ELECTRONIC, ELECTRICAL ENGINEERS for instrumentation and general development work on pilotless aircraft, aeronautical, electronic and electrical equipment and aviation armament. $3000 to $10000 per annum. Better than average housing. Location Naval Air Development Station, Pennsylvania. Box 171.

ENGINEERING GRADUATES interested in development and design of electro-mechanical devices. Work would be in connection with guided missiles, fire control, underwater ordnance, etc. Location Naval Ordnance Laboratory, Maryland. Box 172.

ELECTRONIC DESIGN AND DEVELOPMENT ENGINEER. M.S. or Ph.D. in Electrical Engineering or Physics. Will require a minimum of approximately eight years of extensive original electronic design experience in fields of radar or pulse techniques. Location Oak Ridge, Tenn. Box 173.

ELECTRICAL ENGINEER. With 5 to 8 years of experience in low wattage, wide band amplifiers, sub-miniature tubes and pulse technique. Local area housing available. Location Oak Ridge, Tenn. Box 174.

PHYSICISTS, ENGINEERS. Instrument design and development for guided missiles. Experience in electronic, aeronautic instruments or in mechanical design. Field testing of missiles, part time in laboratory. Technical competence plus experience in directing field operations. Location Washington, D. C. Box 175.

INSTRUMENT APPLICATION ENGINEER must be engineering graduate (electrical, mechanical, chemical) Qualified in instrument specifications. Should have training in instrument application work with emphasis on combustion control. Location Philadelphia, Pa. Box 176.

INSTRUMENTATION ENGINEERS. To aid in selection, development, installation and operation of instruments required for testing rocket propulsion systems and components. Work involves measuring and recording pressures, temperatures, flow and other physical quantities. Applicant must have B.S. in E.E. or in Physics, must have at least two years experience in instrumentation and must have good background in electronics. Experience in rocket motors desirable, experience in testing aircraft power plants acceptable. Location Southern California. Box 177.

PHYSICIST OR ELECTRONIC ENGINEER. Ph.D. or equivalent. Experience with servos, d-c. servo amplifiers, electronic and mechanical computing circuits. Location University of Texas, Austin, Texas. Box 178.

AIRCRAFT INSTRUMENTATION ENGINEER for flight test section of leading helicopter manufacturer. B.S. or M.S. in E.E. or equivalent experience; minimum 3 years experience, preferably aircraft, familiar with electronic measuring devices, pilot experience desired but not necessary. Salary open. Box 179.

PHYSICISTS—B.A., M.A., Ph.D. unusual opportunities in the field of experimental physics are open with Fairchild Engine and Airplane Corp., Oak Ridge, Tenn. Box 180.

ELECTRICAL OR ELECTRONIC ENGINEER. Age 26-35. B.S. or M.S. with 3-8 years experience for design, development and field application engineering of automatic smoke detection systems. Five day, thirty-seven hour week; sick and retirement benefits; permanent; $4500 to start. Location New York City. Box 181.

DEVELOPMENT ENGINEER preferably with mechanical engineering degree and particularly with some experience in design of flowmeters. Location Connecticut. Box 182.

INSTRUMENT ENGINEERS. Permanent positions open in the Drafting Dept. for designers of pneumatically operated industrial instruments and dimensional gages. Require men with previous experience in the design of small mechanisms or dimensional gages, preferably with some educational background in addition to high school. Location Philadelphia, Pa. Box 183.

MECHANICAL ENGINEERS (M.E. or Equivalent) for new product development. Experience in design and manufacture of precision equipment very desirable. Location Buffalo, N. Y. Box 184.

PHYSICISTS. Research in field of development of basic design of new instruments. Location Buffalo, N. Y. Box 185.

PROJECT ENGINEERS. Design and Development in airplane stability and control; aeronautical navigational instruments; servomechanisms; radar; microwave equipment; electronic optics; F. H. motors; pulse transformers. Location Long Island, N. Y. Box 186.

PHYSICIST, M.S. or better age 26-35 to develop automatic fire, burglar, and waterflow detection principles. Permanent; 37 hour five day week; sick and retirement benefits; starting salary to $6000. Location New York City. Box 187.

INSTRUMENT APPLICATION ENGINEERS. M.E., E.E , C.E. Three to five years experience in instrument development, manufacture or application engineering with broad knowledge of operation and function of industrial instruments. Location New York. Box 188.

REFINERY INSTRUMENT ENGINEER. Be able to trouble shoot and instruct instrument men in servicing procedures on all types of refinery instruments. To supervise start-up of new units throughout the country. Must be willing to travel. Headquarters Chicago, Ill. Box 189.

INSTRUMENT SUPERINTENDENT for Iowa Ordnance Plant. Responsible for maintenance and repair of instruments involving flow, temperature, and pressure measurements and controls for process and air conditioning, all of which are very extensive. Salary open. Box 190.

INSTRUMENT SERVICE ENGINEER for servicing and repair of automatic combustion controls. State age and experience. Location New Orleans, La. Box 191.

INSTRUMENT REPAIR MECHANIC for thermometer work. Must know and understand fill-

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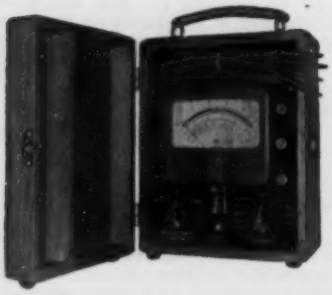

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RANGES

AC-DC Volts:
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DC Current:
0-150 UA/1.5 MA/30 MA/1.5 A/15 A

OHMS:
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DB: —10/0/ +73 in 7 ranges

FEATURES: Highest sensitivity—

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Long mirrored scale—with added center zero range.

Complete with High Voltage test leads.

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Measure from a low of 10 microamperes to a high of 15 amperes—from .2 volts to 7500 volts—from 1 ohm to 50 million—from minus 10 to plus 73 DB.

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ing of capillary tubing of all kinds. Location New Orleans, La. Box 192.

INSTRUMENT FOREMAN to supervise assembly and calibration of electrical indicating instruments. Will be in direct charge of approximately 60 people, mostly women. Must have fundamental working knowledge of electricity and high school education or equivalent. Previous manufacturing experience required. Location Cleveland, O. Box 193.

INSTRUMENT REPAIR MAN who has had thorough experience in the Electrical Instrument field with one or more of the major electrical instrument manufacturers. Location Los Angeles, Calif. Box 194.

INSTRUMENT REPAIR MECHANIC. Experienced in repair of temperature, flow and pressure recording and controlling equipment. Location. Pearl River, N. Y Box 195.

ADMINISTRATIVE PHYSICIST preferably one with experience with optical instruments or electronics. Unusual advantages, promising future. Salary up to $6235.20 per annum. Location California. Box 196.

INSTRUMENT TECHNICIAN to assist in the supervision and training of refinery instrumentmen for foreign service. Also experienced refinery mechanics for foreign service. Age 25 to 30. Salary $325 to $350 per month. Box 197

Manufacturers' New Literature

In this department we report new literature pertaining to Instrumentation, received from the manufacturers. We urge readers to request ONLY those bulletins which will be of value to them. Use the Postage-free Order Card on page 963.

P-478 **Bourdon Tube Gages.** 16-page 8½" × 11" booklet illustrates and explains maker's Bourdon gages, custom-built in ranges to 10,000 lbs./in.², individually calibrated, engraved dial, accurate to one part in 500 or better. Heise Bourdon Tube Co., Inc., Brook Rd., Newtown, Conn.

P-479 **Solenoid Contactors.** 4-page 8½" × 11" Bulletin 4452 and 4453 pertains to maker's new size 2 (50 amperes) and size 3 (100 amperes) solenoid type a-c. contactors. Ward Leonard Electric Co., 31 South St., Mount Vernon, N. Y.

P-480 **"Modern Precision."** 8-page Vol. 8, No. 2 issue of this house organ contains articles of interest in the field of metals, process industries, ceramics, power, research, teaching and testing. Leeds & Northrup Co., 4902 Stenton Ave., Philadelphia 44, Pa.

P-481 **Insulation Tester.** 4-page 8½" × 11" Bulletin 450 describes maker's new "Minor" megohmer, weighing 3 lbs. and having a d-c. generator with a 500 volt d-c. output. Range: 0-50 megohms and infinity Herman H. Sticht Co., Inc., 27 Park Place, New York, N. Y.

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PRESSURE TRANSDUCER

The improved type 4512 Giannini Pressure Transducer is smaller and lighter than standard instruments. This instrument combines smaller size with high outputs and accurate readings. Even at low pressures, it retains all of its accuracy.

This absolute, differential, or gauge-type Pressure Transducer is available in ranges up to 40 psi. The new type 4512 is available for immediate delivery.

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Bulletin 330-C

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